SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER, 1929.

GENERAL PHYSICS.

3447. Molecular Length Measurement by an Optical Lever. W. N. Bond. *Phil. Mag.* 7. *pp.* 1163–1182, *June,* 1929.

The optical lever used is a piece of a hack-saw blade, about 1 cm. square, provided with a needle point and resting with small ball-bearings of steel on a brass table, through which the pole pieces of two cobalt-steel bar magnets, flush with the table plane, and an adjustable screw of hardened steel penetrate; the tip of the screw is slightly convex. The lever, to which a mirror is fixed, is tilted by a gentle air blast from a rubber bulb, and the needle compresses the specimen, resting on the screw tip, when returning to the vertical position; the magnets prevent slipping of the lever. When a series of experiments is made with mica (muscovite), the apparent thickness of the mica, and also the penetration into the steel, when mica is not interposed, show a periodicity, *viz.*, 10·0 (mica) and 6·8 (steel) $\times 10^{-8}$ cm. These periodicities agree with the lengths of the unit cells of mica and of cementite, as determined by X-rays. It is suggested that the needle point ruptures the surface layer of the crystal (mica or steel), the layer flowing radially outward under the pressure till the needle comes to rest on the first intact layer. The local contact pressures, of 30,000 or 180,000 atmospheres, would be sufficient to cause flow of the material. H. B.

3448. New Conimeter. F. Löwe. *Zeits. f. Instrumentenk.* 49. *pp.* 296–298, *June,* 1929.

The apparatus consists of a form of dust counter in which a measured volume (5 cc. or 2·5 cc.) of air deposits its dust on to a small portion of a plate, and this is viewed through a high-power microscope possessing a dark field condenser. On each plate 30 samples can be projected, equally spaced, and these can be examined at leisure afterwards, or, since the whole apparatus is portable, at once. The apparatus has applications for measuring the dust content in a mill, factory or mine, and for the last is useful in the prevention of explosions. R. S. R.

3449. Hygrometer for Use in Timber-Seasoning Kilns. E. Griffiths. *Phys. Soc., Proc.* 41. *pp.* 426–427, *June* 15, 1929.

The hygrometer is of the wet and dry bulb type using mercury-in-steel thermometers. The bulbs and capillaries are enclosed in a steel tube which can be inserted through a hole 3 in. in diameter, and explorations up to 12 ft. can be made with it. One dial serves both thermometers, the two pointers being arranged so that one moves over the top face of the dial and the other is brought round from beneath on to the outside edge. An electrically-operated fan draws air past the two bulbs. The moistening of the covering over the wet bulb is effected in two ways: (*a*) by a reservoir; (*b*) by connection to an external water supply.

AUTHOR.

3450. High Vacuum Pump of High Performance. W. Gaede and W. H. Keesom. *Zeits. f. Instrumentenk.* 49. *pp.* 298–300, *June*, 1929.

Particulars are given of an improved form of mercury diffusion pump which has a rate of extraction amounting to 130 litres/sec. for air and 422 litres/sec. for helium, this being about eight times better than former pumps. R. S. R.

3451. Effects of Pressure on the Properties of Matter. P. W. Bridgman. *Phys. Soc., Proc.* 41. *pp.* 341–360, *June* 15, 1929.

Contains numerous graphs illustrating the behaviour of various substances under pressures, which in some cases reach 20,000 kilogrammes per sq. cm. At low pressures the decrease in volume of a gas with pressure has its origin in a decrease of the empty space between the molecules, but in the end they are pushed into contact and any further diminution in volume indicates a compression of the molecules themselves; the compression of N_2 becomes larger than that of He, because the structure of the former is more complicated than that of the latter. The isothermal compressibility of liquids and solids at high pressures, thermal dilatation, instantaneous compressibilities, polymorphic transitions, relative electrical resistances, thermoelectricity, thermal conductivity, viscosity and shearing modulus are dealt with. The effects are in several instances complicated, and some theoretical suggestions are made. Apparently essentially different aspects of the electron mechanism are involved in thermoelectricity and resistance. H. N. A.

3452. Capillary Phenomena in Non-Circular Cylindrical Tubes. W. O. Smith and P. D. Foote. *Indust. & Engin. Chem.* 21. *pp.* 567–568, *June*, 1929.

The authors deduce as an approximation the equation $z_0 = \sigma P \cos\theta/\rho g A$, where z_0 is the height of the lowest point of the meniscus above the free liquid, σ is the surface tension, P the perimeter of the cross-section of the tube, θ the angle of contact, ρ the density, g the acceleration of gravity, and A the cross-sectional area of the tube. For a tube of rectangular cross-section with the sides a and b the equation becomes $z_0 = 2\sigma(a + b)/\rho g a b$, and for an elliptical tube having the semi-axes a and b it is $z_0 = 4\sigma E(k)/\pi b \rho g$, where $E(k)$ is the complete elliptic integral of the second kind and $k = (1 - b^2/a^2)^{\frac{1}{2}}$. The vapour pressure over a meniscus surface is different for circular and non-circular capillaries of the same cross-sectional area. In a closed system where p_0 is the vapour pressure over the free liquid, p_1 that over the meniscus and d the mean vapour density, $p_0 - p_1 = d\sigma P \cos\theta/\rho A$, which is usually sufficient for practical purposes. T. C. H.

3453. Viscosity Formula for Binary Mixtures, the Association Degrees of Constituents being Taken into Consideration. T. Ishikawa. *Chem. Soc. Japan, Bull.* 4. *pp.* 149–152, *June* 1929.

Uses the slightly modified formula $\log \eta = a + bM$ to express Dunstan and Wilson's law, where M is the molecular weight. Gives tables with the values of a and b at different temperatures for a number of paraffins and organic iodides, monobromides, sulphides and fatty alcohols. a varies very little with temperature, and is nearly the same for all the compounds tabulated, b varies with the temperature, but has nearly the same value for each homologous series, so that for 20° C. the author writes log $\eta = -3\cdot 22 + b\mathrm{M}$. Studies the relation between b and the field constant k, and finds that for a number of liquids the ratio between the value of b for C_6H_6 and that for the liquid is fairly concordant with the value of k for the liquid. H. N. A.

3454. Determination of Pore Diameters in Ceramic Filters by the Systems Air/Liquid and Liquid/Liquid. H. Bechhold and R. Schnurmann. *Zeits. f. phys. Chem.* 142. *Abt. A.* 1. *pp.* 1–24, *June*, 1929.

The determination is made by the method of Cantor, 1892, by measuring the pressure required to force air bubbles through the capillaries previously filled with a liquid of known surface tension. The wetting should be complete, the capillaries circular in cross-section, and the edges sharp. As ceramic filters have pores of different widths, the first bubble appearing will mark the widest pore. Subsequently many bubbles will be seen at pressures indicating the average pore width. The liquids used are water, various alcohols, acetone, benzene, etc. The filters tested were three types of Berkefeld filters, one filter from the Berlin Porcelain Factory, four types of Schott glass filters, and six types of Chamberland candles. As long as the pores were not larger than 4 μ, the different liquids gave fairly the same, but not quite the equal values expected. Pores down to 1 μ and less could be measured at pressures of about 1 atmosphere. For impregnation with water pressures of 3 atmospheres were required, which some filters would not bear. Water/air and carbon disulphide/air gave larger pore diameters than the other liquids when the pores exceeded 4 μ. In order to avoid the high pressures required to replace air by water, the filters were impregnated with water, which was then replaced by a liquid with which it does not mix, *e.g.*, isobutyl alcohol or sodium salts (lysalbinate or protalbinate, etc.). The pore widths then deduced were only one-half or one-tenth of those obtained with liquid/air systems. The very small liquid drops would not coalesce as readily as gas bubbles, and the wetting may have been imperfect. But it remains uncertain which of the values, the air/liquid or liquid/liquid, are the more correct. H. B.

3455. Fundamental Problem of Vortex Theory. J. Delsarte. *Comptes Rendus*, 188. *pp.* 1655–1657, *June* 24, 1929.

Difficulties inherent to Poincaré's discussion of vortex motion of a perfect fluid in a simply-connected vessel, the vorticity being known, are referred to, and a solution of Poincaré's problem, velocities at the surface of the vessel being known, is derived. [See Abstract 2343 (1929).]

J. S. G. T.

3456. Frictional Resistance and Pressure Decrease. S. Tarassenko. *Phys. Zeits.* 30. *pp.* 403–407, *June* 15, 1929.

The author applies the laws of pressure decrease in a cylindrical tube with large Reynolds numbers to a vortex in order to find the frictional resistance to a rotating disc and the magnitude of the pressure decrease in a smooth channel. Equations are established for a rotating disc, and these agree better with the experimental results of Kempf and Schmidt than with the formula of v. Kármán for low Reynolds numbers. Equations are next established for motion in a cylindrical tube, and these agree better with Fromm's experimental results than does the Blasius equation. It is concluded that the Blasius equation holds as an interpolation formula only for Reynolds numbers not exceeding 9×10^4. [See Abstract 3101 (1929).]

R. S. R.

3457. Stability of a Kármán Vortex Street in a Channel of Finite Breadth. Part I. S. Tomotika. *Phys. Math. Soc. Japan, Proc.* 2. *pp.* 53–68, *May–June*, 1929. *In English.*

The solution of the problem of the flow due to a double row of vortices in a channel is obtained in terms of elliptic functions. The velocity of the vortices is parallel to the sides of the channel only if they are opposite one another in pairs, or those of one row opposite to the centres of the spaces in the other. By considering a small displacement (the same for all vortices) it is shown that the first type is unstable, while the second is if the width of the row is more than 0·22 of the breadth of the channel. If the width is less than this there is at least one stable configuration, but the spacing differs from the Kármán result. W. G. B.

3458. Systems of Double Sources in Plane Streaming, Especially the Streaming Round Two Cylinders. W. Müller. *Zeits. f. Angew. Math. u. Mechanik*, 9. *pp.* 200–213, *June*, 1929.

By considering the effect of a pair of double sources in a stream, an approximation to the forces acting upon two cylinders is obtained, the formula being $\frac{1}{2}\pi\rho v^2 a(a/b)^3$, where v is the undisturbed velocity, a the radius, and b the distance between centres. By considering the infinite series of images, the exact formula unrestricted as to the smallness of a/b is obtained. The case of a cylinder near a plane wall is a special case, and some indication of the effect of the ground upon an aeroplane at low altitudes is thus obtained. W. G. B.

3459. Study of Air Vibrations. Z. Carrière. *J. de Physique et le Radium*, 10. *pp.* 198–208, *May*, 1929.

Describes a method for the study of the extent and mode of vibration of the air in a cylinder or other vessel, using an ultramicroscope and strongly illuminated white powder suspended in the air. Different powders were used, and the rate of translation was observed. The air was then set in vibration by means of a telephone diaphragm electrically vibrated, and the individual particles of powder were found to execute straight-line paths, in fact they appeared as short bright lines in the field of the microscope. The length and direction of a line gave the extent and direction of the vibration at the point observed. By this method it was found that in a cylindrical tube, the amplitude of vibration was constant over the greater part of the section, but was greater in a region close to the walls and fell to zero at the walls themselves. The mode of the vibration near an obstacle placed in the cylinder was also studied. It was found that the vibration of a particle near the obstacle, instead of being a straight line, was a deformed ellipse. The paper contains diagrams showing the curves obtained. J. W. T. W.

3460. Flow in Curved Tubes and Wings. L. S. Da Rios. *Accad. Lincei, Atti*, 9. *pp.* 729–736, *May* 5, 1929.

The author gives a mathematical treatment of the problem of air flow within and around a curved tube of rectangular cross-section. He then treats the isolated aerofoil both thin and of finite thickness. He compares the results of this theory with d'Alembert's paradox, and then with the theorem of Kutta-Joukowski. J. W. T. W.

3461. Wind Tunnel for Studying Two-Dimensional Flow. A. Martinot-Lagarde. *Comptes Rendus*, 188. *pp*. 1596–1597, *June* 17, 1929.

Describes a special form of wind tunnel designed for the study of the air-flow about a structure of uniform section extending from one side of the (square) tunnel to the other. The vertical sides were constructed of plate glass so that photographs could be taken of the striations produced when the air was drawn along the tunnel. These striations were due to hot-air currents caused by electrically heated wires placed across the bottom of the tunnel. The dimensions of the tunnel were 20 cm. square and 25 cm. long. J. W. T. W.

3462. Stresses in a Rotating Circular Disc of Small but Varying Thickness. T. Suhara and H. Yaskawa. *Imp. Acad. Tokyo, Proc*. 5. *pp*. 72–74, *Feb*., 1929.

The derivation of a general formula showing the stress components in a rotating disc calculated so as to be applicable to all speeds. The solution is an approximate one, but is claimed to be of sufficient accuracy to act as a guide for the practical design of flat discs of the high-speed type. S. G. B.

3463. Motion of Two Variable Attracting Masses. M. Manarini. *Accad. Lincei, Atti*, 9. *pp*. 499–504, *March* 17, 1929.

With reference to the note of Levi-Civita [see Abstract 1757 (1929)], the author revives certain conceptions of Armellini on the same subject dating from 1915. E. E. F. d'A.

3464. Acceleration in the Movement of a Plane Figure. V. Foschi. *N. Cimento*, 6. *pp*. 217–229, *May*, 1929.

An investigation into the properties of the accelerations of the different points in a plane figure moving in its plane, with the view of arriving at simple constructions for the determination of the accelerations of different points when the motion is defined. If from all the points of a plane figure there be drawn vectors which represent the total accelerations of the points, the extremities of these vectors form a figure similar to the given figure and orientated orthogonally to it. A. D.

3465. Theorem of Maximum Kinetic-Dynamic Effect. E. Gugino. *Accad. Lincei, Atti*, 9. *pp*. 736–742, *May* 5, 1929.

The author extends the theorem of the maximum kinetic-dynamic effect to the motion of a system of particles connected by means of unilateral bonds, and shows how the result may be applied in studying the motion of such a system. J. W. T. W.

3466. Problem of the Lines of Principal Stress in Plastic Materials. F. Löbell. *Zeits. f. Angew. Math. u. Mechanik*, 9. *pp*. 213–225, *June*, 1929.

The investigation would seem to show that, starting from the conditions of equilibrium alone, one is led to more than one condition for the determination of the lines of principal stress. W. G. B.

3467. Inertial System. K. Kommerell. *Zeits. f. Angew. Math. u. Mechanik*, 9. *pp*. 225–230, *June*, 1929.

Criticises the idea of the inertial system, whether defined as one relative to which a freely moving body traces out a straight line with uniform velocity, when "freely" and "uniform" are not capable of independent definition; or as the system referred to which the kinetic energy is a minimum. W. G. B.

3468. Simple Method of Fitting a Straight Line to a Series of Observations. J. H. Awbery. *Phys. Soc., Proc.* 41. *pp.* 384–389; *Disc.*, 389–391, *June* 15, 1929.

A method is described for determining the constants in a straight line to represent a series of data. It has a rational basis, and can be carried out in one-third or one-quarter of the time required to apply the method of least squares; it avoids the multiplications and squarings essential to that method, and has the advantage that at no stage does it necessitate the use of more significant figures than are presented in the data to be analysed. The results of the method are compared with those obtained by the method of least squares, on some accurate, and also on some very scattered, observational material. In both cases, the saving of time and labour lead to a negligibly small decrease in accuracy, as compared with the older method. AUTHOR.

3469. Spinels of the Type $Me^{II}Me^{IV}O_4$. G. Natta and L. Passerini. *Accad. Lincei, Atti*, 9. *pp.* 557–563, *April* 7, 1929.

Cobaltous orthostannate (CO_2SnO_4) and magnesium orthostannate (Mg_2SnO_4) have a reticular structure belonging to the type 8*f*, 16*c*, 32*b* (space-group Oi7), and corresponding to that of spinels. For the parameter which defines the position of the oxygen the value is approximately 1·8. A. D.

3470. Grating Dimensions and Phases of the Magnetic Substance Fe_xSb_y. I. Oftedal. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 67–70, *June*, 1929.

In consequence of some disagreements found in the author's previous measurement, the work was again repeated with a new preparation. The earlier work was confirmed again, and the cause of the aberrations are now being investigated. [See Abstract 3033 (1927).] J. E.

3471. Structure of Norbergite. W. H. Taylor and J. West. *Zeits. f. Krist.* 70. 5–6. *pp.* 461–474, *June*, 1929. *In English.*

The structure of norbergite, $Mg(F, OH)_2Mg_2SiO_4$, has been determined by a qualitative method using X-rays. It is based on a simple orthorhombic lattice, space group V_h^{16}, the unit cell containing 4 molecules. The structure found fits excellently into the scheme proposed earlier for the other members of the chondrodite series (chondrodite, humite and clinohumite) [see Abstract 1152 (1928)]. The 4 members of the series bear a strong crystallographic resemblance to each other and to olivine, and have long been interesting as an outstanding example of morphotropy. All the structures are based on a hexagonal close-packed arrangement (somewhat expanded) of oxygen atoms and hydroxyl groups (or fluorine atoms), amongst the interstices of which are distributed the magnesium and silicon atoms. Each silicon atom is found to be surrounded by a group of 4 oxygen atoms, whilst each magnesium atom is surrounded by a group of 6 atoms, composed of 4 oxygen atoms and 2 hydroxyl groups (or fluorine atoms). The arrangement in each crystal is such as to constitute a set of alternate slabs—parallel to (001) — of Mg_2SiO_4 and $Mg(F, OH)_2$, the Mg_2SiO_4 portion reproducing the olivine structure. Whilst the thickness of the slabs of $Mg(F, OH)_2$ remains constant throughout the series, the thickness of the slabs of Mg_2SiO_4 (olivine) varies with the crystal, the ratio of the thicknesses being proportional to the Mg_2SiO_4 content. AUTHORS.

3472. Crystal Analysis of Solid α-Nitrogen. J. de Smedt, W. H. Keesom and H. H. Mooy. *K. Akad. Amsterdam, Proc.* 32. 6. *pp.* 745–748, 1929. *In French. Comm. No.* 202A *from the Phys. Lab. Leiden.*

An X-ray spectrogram of solid nitrogen has been obtained giving a dozen lines. The series is accounted for either by a cubic cell with $a = 5\cdot656$ Å. or by a tetragonal cell with $a = b = 4\cdot00$ Å. and $c = 5\cdot656$ Å. Also, since the cubic cell is simply a special case of a rhombohedral cell with axial ratio 1·225, there are three possibilities. The fact that solid nitrogen shows double refraction limits the choice to the tetragonal or the rhombohedral. The rhombohedral cell would require 8 atoms to satisfy the density, and this would mean that 2 atoms would have a different symmetry from the other 6. Therefore the tetragonal cell with 4 atoms is considered the most probable. J. E.

3473. Crystallographic and Optical Investigations on Adrenalin-chlorhydrate. W. Faber. *Zeits. f. Krist.* 70. 5–6. *pp.* 497–505, *June*, 1929.

The author examines in detail the difficulties encountered in determining refractive indices for organic substances. The substance considered crystallises in the monoclinic form as a prismatic crystal and in the rhombic form as plates. The values obtained for the refractive indices and angles of these crystals are given. R. S. R.

3474. Constitution and Density of Particles in Precipitated Smokes. H. P. Walmsley. *Phil. Mag.* 7. *pp.* 1097–1112, *June*, 1929.

Smoke clouds were formed by striking an electric arc in air between metallic electrodes. They were precipitated in a glass tube lined with a sheet of aluminium foil, and containing a central insulated brass rod which was charged to a high potential. The material was analysed by the powder method, and a table gives the results obtained in different cases. The composition could be identified from the lines observed, the dimensions of the unit cells agreeing with those observed on large specimens by other experimenters. In some cases there were two oxides mixed together, and in others the material was formed of metallic crystalline particles. The low density of the precipitated smoke, which had previously been noted, is shown to be due to the way in which the minute crystals are united together, the structure being of the same nature as that of snow as compared with that of ordinary ice. The particles are ultramicroscopic, and may be faceted like microscopic crystals. In an electric field they form thread-like aggregates, and it may be that two facets of two of the minute crystals are united to one another, and so on along the chain. H. N. A.

3475. Parachor and Chemical Constitution. Part XI. Arsenic and Selenium Compounds. W. J. R. Henley and S. Sugden. *Chem. Soc., J. pp.* 1058–1065, *June*, 1929.

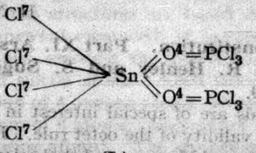
The parachors of selenium compounds are of special interest in connection with the question of the general validity of the octet rule. From the close chemical analogy with sulphur it would be expected that selenium in the selenoxides and high halides would develop these valencies by means of semipolar double bonds or singlet linkages, but recent work by Kenyon and collaborators has revealed certain characteristic differences between the behaviour of compounds of quadrivalent selenium and sulphur, which has raised the possibility that the octet rule might not hold for selenium. The results of the present investigation strongly support the application of the octet rule to selenium compounds, and are opposed to any interpretation of the differences between sulphur and selenium compounds, which is based upon the presence of a group of more than eight electrons around the selenium atom. The parachors for selenium and arsenic are given as 62·5 and 50·3 respectively. H. H. Ho.

3476. Parachor and Chemical Constitution. Part XII. Fused Metals and Salts. S. Sugden and H. Wilkins. *Chem. Soc., J. pp.* 1291–1298, *June*, 1929.

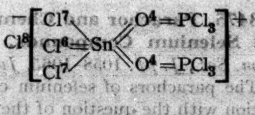
This paper deals with the parachors of conducting liquids (metals and salts). The parachor of a salt involves the constant for a polar bond, and it has already been argued [see Abstract 2416 (1927)] that this linkage should have the same effect upon the parachor as a semi-polar double bond, *viz.*, − 1·6 units. A direct test of this hypothesis is provided by the parachors of certain salts of organic bases which are fusible without decomposition, and values for six salts derived from secondary, tertiary and quaternary bases gave satisfactory results. Anomalies are discussed. In the cases of metals the results indicate that some other factor has to be taken into account to explain the many large positive anomalies found, which may be due either to the presence of a high concentration of ions or of loosely-bound electrons or else to some special condition of the metallic atom. With salts, the bromides and iodides usually give the highest values for the metallic parachors, and the sulphates, nitrates, phosphates, and particularly the fluorides give much lower figures. H. H. Ho.

3477. Parachor and Chemical Constitution. Part XIII. Some Compounds of Titanium and Tin. F. B. Garner and S. Sugden. *Chem. Soc., J. pp.* 1298–1302, *June*, 1929.

The chief object of this investigation has been the elucidation of the structure of the additive compound of stannic chloride and phosphorus oxychloride, and as a preliminary step the parachors of a few simple tin and titanium compounds were measured which gave the atomic constants Sn = 56·7 and Ti = 45·3. Casselman's composition of $SnCl_4 . POCl_3$ is disproved and $SnCl_4 . 2POCl_3$ established which falls into line with the corresponding compounds of zirconium and hafnium, *viz.*, $Zr(Hf)Cl_4 . 2POCl_3$, and $Zr(Hf)Cl_4 . 2PCl_5$. It is concluded that the small conductivity shown by fused $SnCl_4 . 2POCl_3$ is due to traces of moisture and that the molecule must be non-polar and probably represented by structure I, although the parachor shows that it is large dissociated into its generators (II) in the liquid state.



(I.)



(II.)

H. H. Ho.

3478. Isotope of Oxygen, Mass 18. Interpretation of the Atmospheric Absorption Bands. W. F. Giauque and H. L. Johnston. *Am. Chem. Soc., J.* 51. *pp.* 1436–1441, *May*, 1929.

A consideration of the available data from spectroscopic records shows that no revision of Mulliken's interpretation of the atmospheric absorption bands of oxygen is necessary. A further study of the bands, together with additional data, explains the presence of a weak band in the atmospheric absorption of oxygen and demonstrates the presence of an isotope of oxygen, mass 18, present in small amount. S. G. B.

3479. Rutherford-Bohr Systems. U. Crudeli. *N. Cimento*, 6. *pp.* 243–248, *May*, 1929.

Deals with the various systems of the atom of Rutherford-Bohr, especially the triangular and quadrangular systems in uniform rotation.

E. E. F. d'A.

3480. Mechanical Ionisation of Gases by Extreme Pressure at Low Temperatures. W. Anderson. *Phys. Zeits.* 30. *pp.* 360–364, *June* 1, 1929.

P. W. Bridgman [see Abstract 1280 (1927)] has expressed the opinion that all gases can be ionised at low temperatures if subjected to sufficient pressure. The author corroborates this on Bohr's theory by quantum considerations. At zero temperature this "mechanical" ionisation of atomic hydrogen sets in as soon as the pressure reaches $3\cdot5 \times 10^6$ atmospheres, when the density is $0\cdot4061$ g. cm^{-3}. This clears up one of the difficulties encountered by Eddington, according to which a star at a certain stage requires energy in order to cool. E. E. F. d'A.

3481. Distribution of Charge in the Carbon Atom. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 402–411, *April*, 1929.

The theoretical distribution of charge in the atom is known from its F curve, the scattering of the atom for X-rays, and this is a function of the glancing angle of incidence θ and the wave-length λ. The theoretical curve for a free carbon atom is deduced and compared with experimental results. The differences obtained are greater than the probable experimental errors, particularly for large values of $\sin\theta$, where the calculated curve is known most accurately. The differences are shown not to be due to thermal vibrations of the atom, to the possible existence of zero point energy in the diamond lattice, or to distortion of the L electrons in the carbon atom which may occur in the diamond. It is possible, though improbable, that they are due to distortion of the K electrons. When investigating the asymmetry of the carbon atom experimentally by X-ray methods, spectra which occur between $\sin\theta = 0\cdot10$ and $0\cdot30$ are of special importance since over this range the contributions of the L electrons to the F curve vary most rapidly, while little is gained by studying spectra for $\sin\theta \geqslant 0\cdot40$. [See Abstract 50 (1929).] R. S. R.

3482. Hyperfine Structure in Triplet Spectra and its Meaning in Connection with the Determination of Nuclear Moments. H. Schüler and H. Brück. *Zeits. f. Physik*, 56. 5–6. *pp.* 291–296, 1929.

The assumption of a nuclear moment, which is constant for all atomic states, makes it necessary to introduce new term schemes which have been previously discussed for doublet spectra, and are now dealt with for triplet spectra. The following table shows the nuclear moments deduced for four elements:—

Element.	Protons in Nucleus.	Electrons in Nucleus.	Nuclear Moment.
Bi	208	125	9/2
Tl	204	123	1/2
Cd	110	62	0
	111	63	1/2
	112	64	0
	113	65	1/2
	114	66	0
	116	68	0
Zn	64	34	0 (?)
	66	36	
	68	38	
	70	40	

The nuclear moment 9/2 for bismuth is taken from Back and Goudsmit. It is necessary to assume that different isotopes of Cd have nuclear moments 0 and 1/2; the authors assume that the first group contains those with an even number of electrons in the nucleus, and the second those with an odd number. Zinc with an even number of electrons in all isotopes has no fine structure, and the nuclear moment appears to be zero. H. N. A.

3483. X-Ray Absorption Limits and the Distribution of Electrons round the Atom. B. B. Ray. *Indian Journ. Phys.* 3. *pp.* 477–488, *June* 15, 1929.

Kossel's view on the structure of the atom and the energy levels are not restricted to cases in which the absorption edges show a fine-line structure. Pure elements do not show this stucture; that does not prove that it is non-existent. Coster and van der Tuuk [see Abstract 1841 (1926)] observed the K fine-lines in argon. The K limit corresponds to the energy necessary to transfer an electron from the K shell to the periphery, and the secondary edges are due to the removal of an electron from the K shell to some virtual optical level. Both the frequency of the edges and the emission lines of an atom change with different chemical combinations of the same atoms. The K energy level of sulphur is 181·85 for the element; in sulphates it is 182·68, difference 0·83; the LII are 11·96 and 12·70, difference 0·74. That the differences are greater for the K than for the L seems contrary to expectation, but an explanation is suggested. Following Lindh [see Abstract 2109 (1924)] and Nuttall [see Abstract 2407 (1928)], the author finds that in the different elements of a compound of similar structure the separation of the K edge in the elementary atoms from the corresponding edge of the same atoms in the compound is the same, but not all the secondary absorption limits can be explained by Kossel's hypothesis (Nuttall). The discontinuities in the curve obtained by plotting $\Delta v/R = K - K_\beta$ (Siegbahn) (where K and K_β denote the v/R for the absorption limit and K_β emission line) from aluminium to zinc support Saha's electronic distribution in the atom rather than that of Main Smith and Stoner. H. B.

3484. Structure of Atomic Nuclei. M. F. Soonawala. *Indian Journ. Phys.* 3. *pp.* 489–492, *June* 15, 1929.

Atomic nuclei are formed by the synthesis of protons, electrons and rare-gas nuclei. The halogens and metals of the alkalis and alkaline earths represent similar combinations of protons, the nuclei and other rare gases. The combinations of the isotopes of A and Ne would yield nuclei of the atomic weights of the rare-earths metals. Combinations of the isotopes of Kr would give other rare earths, from Tb to Lu; but it is doubtful whether the isotopes of Kr can themselves combine with one another. Combinations of the isotopes of Kr and Xe would build up the radioactive elements. The author's arrangement of the elements shows diminishing frequency of occurrence. He expects further discoveries of isotopes. H. B.

3485. Dissociation of Molecules by Rotation. O. Oldenberg. *Zeits. f. Physik*, 56. 7–8. *pp.* 563–575, 1929.

The principle of selection deduced by Franck and Condon from mechanical conservation laws for the distribution of intensities of nuclear vibrations in band spectra is applied to the rotation of molecules by the principle of the conservation of the moment of momentum. On this basis the abrupt cessation of bands at high rotation quantum numbers is explained. The energy curves, which give an indication of the stability of the rotating molecule, show a labile point for an energy value which under certain circumstances far exceeds the work of dissociation of the molecule, and for a nuclear distance which only slightly exceeds the equilibrium value. The theory, which is confirmed by the example of HgH, differs from the conception of Franck and Sponer in leading to the conclusion that the observation of an abruptly terminating series of rotation quanta—as opposed to the corresponding phenomenon in nuclear vibration quanta—does not make it possible to calculate the work of dissociation. A. J. M.

3486. Production of Molecular Rays of Uniform Velocity. B. Lammert. *Zeits. f. Physik*, 56. 3–4. *pp.* 244–253, 1929.

An apparatus is described for the production of rays of mercury atoms of uniform velocity. A direct experimental demonstration has been obtained of Maxwell's law of the partition of velocities. F. J. W.

3487. Collision Problem in the Wave Mechanics. C. G. Darwin. *Roy. Soc., Proc.* 124. *pp.* 375–394, *June* 4, 1929.

Heisenberg's principle indicates that observation of a particle can be made once only. In an experiment in which a sequence of events is observed, the principle requires that at each observation the wave system be given its particle interpretation, although each stage of the experiment is worked out on the wave theory. The final observation must, however, be the same whether the intermediate observations are made or not, and it must therefore be possible to carry the wave calculations through the whole experiment postponing the introduction of the particle interpretation to the end. An ideal experiment is conceived in which two particles collide and can either be observed (by scintillation) or alternatively a mirror can be suitably placed to reflect one of the particles so that a second collision takes place, the scintillations produced by the particles after their second collision then being observed. The occurrence of second collisions in this way appears to imply particles in a part of the experiment where they are not observed, but it is shown by an analysis of the problem using wave mechanics that a full explanation is obtained without appeal to particle notions (except for the final interpretation). The idea of postponing the interpretation of the wave mechanics characterisation of events is extended. By including more terms in the wave equation and modifying the boundary conditions, the zinc blende scintillation, the stimulation of the retina, the innervation of the optic nerve, etc., can all be described in terms of the wave function ψ, but at some point in the brain consciousness is animated and particle interpretation occurs. In this way, the irreconcilability of wave and particle is pushed back to the boundary between objective and subjective where in any case apart from quantum theory there is an inexplicability. W. S. S.

3488. Connection between Classical and Quantum Mechanics. A. Korn. *Zeits. f. Physik*, 56. 5–6. *pp*. 370–377, 1929.

The author has previously indicated a foundation for a mechanical theory of series spectra, the further development of which fits in well with Schrödinger's investigations in wave mechanics [see Abstract 370 (1920)]. The idea is propounded that the motions, which material particles carry out under the influence of a mechanical force function, may have vibrational movements superposed on them when quite small modifications are made in the strict assumptions of classical mechanics. These characteristic vibrations are supposed to take place about the principal orbit determined by the laws of classical mechanics. It is shown mathematically that the assumption of compressibility in the material particle considered gives a modified Hamilton Jacobi equation, which leads to a superposition of such small vibrations on the classical motion. The eigen functions and eigen values of these vibrations agree with those of Schrödinger. The author regards the minute material and electrical particles as formed from a whole universe of more minute particles, flying about irregularly in something the same manner as the molecules in a gas. He considers that the same ideas can be made use of to explain gravitation. H. N. A.

3489. Loci of Congruence and Absolute Parallelism. E. Bortolotti. *Accad. Lincei, Atti*, 9. *pp*. 530–538, *April* 7, 1929.

Mathematical. Develops Einstein's 1925 theory of a unique field for gravitation and electricity, especially with reference to loci of congruences and absolute parallelism. A. D.

3490. Einstein's 1925 Theory. A. Palatini. *Accad. Lincei, Atti*, 9. *pp*. 633–639, *April* 21, 1929.

Einstein's 1925 theory starts from a Hamilton principle with an appropriate universal constant, and reaches satisfactory analytical results. But, apart from the universal constant not being univocally determined, the results are first approximations only, which Einstein ingeniously shows how to transform into exact equations; but he does not finally deduce the required exact equations. The author shows how, by the use of simple known operators, to deduce the exact equations; but then these do not satisfy the condition that they shall reduce to general relativity equations when the electric field is annulled. A certain univocal value for the universal constant, however, enables satisfactory results to be reached. A. D.

3491. Einstein's New Theory and Quantum Theory. I. Tamm. *Comptes Rendus*, 188. *pp*. 1598–1600, *June* 17, 1929.

A rational wave-equation differing from the Schrödinger–Dirac equation by expressions of the second order is derived on the assumption that the tetrahedral q-vectorial components are known constants in all cases, and that the wave-equation has the same form in the presence as in the absence of a field of force. In this latter respect the theory differs from Dirac's, and the geodesics of the theory necessarily differ from those of Einstein's theory. J. S. G. T.

3492. Linear Quantum Geometry and Parallel Displacement. V. Fock and D. Iwanenko. *Comptes Rendus,* 188. *pp.* 1470–1472, *June* 3, 1929.

Linear quantum geometry is based on the linear differential form $de = \sum_{\gamma} \gamma_{\nu} dx_{\nu}$ where the γ_{ν}'s are Dirac's four row matrices [see Abstract 2960 (1929)]. It is shown that just as Riemannian geometry can be based on the study of the parallel displacement of a vector, the present linear geometry is derivable, using the notion of parallel displacement of a newly defined type of magnitude termed a demi-vector. W. S. S.

3493. Electron and Gravitation. H. Weyl. *Zeits. f. Physik,* 56. 5–6. *pp.* 330–352, 1929.

The theory of the relationship between the general theory of relativity and the field equations of the quantum theory of the spinning electron discussed in a previous paper [see Abstract 2689 (1929)] is here developed at greater length. The basis of the theory is Einstein's classical relativity theory, without reference to distant parallelism. J. S. G. T.

3494. Schwarzschild's Equation in General Relativity. G. Maneff. *Zeits. f. Physik,* 56. 5–6. *pp.* 421–431, 1929.

It is shown that, starting from the equations of general relativity, theory, Schwarzschild's equation for the metric in the neighbourhood of an isolated mass point is dimensionally correct only if the Einstein measure system ($C = 1$) is employed, and not the absolute system. W. S. S.

METEOROLOGY AND GEOPHYSICS.

3495. Dependence of the Mobility of Ions in Air on the Relative Humidity. E. Griffiths and J. H. Awbery. *Phys. Soc., Proc.* 41. *pp.* 240–247; *Disc.,* 247, *June* 15, 1929.

Using a modification of Zeleny's method [see Abstract 2420 (1900)] an examination was made of the relationship between the mobility of negative ions in air at atmospheric pressure and the relative humidity with a view to possible applications in hygrometric measurements. The end of a wind channel was closed by a disc of gauze fitted with a guard ring through which a steady stream of air of definite humidity was pumped. The motion of the negative ions (given by a small quantity of polonium) due to the action of the air stream was balanced by a counter potential gradient, and the mobility was deduced from the critical potential required to produce a balance. The results obtained show that as the humidity increases from 0 to 100 % the relative mobility of the ions decreases in an approximately linear manner from 1·00 to 0·82. A. W.

3496. Effective Nocturnal Radiations. P. Dubois. *Gerlands Beitr. z. Geophys.* 22. 1–2. *pp.* 41–99, 1929.

The term "effective radiation temperature difference" (E.R.T.D.) is introduced and equations are established to give (1) the effective partial spectral radiation to a polytrope atmosphere, (2) the effective total radiation to a grey radiative atmosphere, and (3) the inversion absorption at which the maximum radiation exchange between the atmosphere and the earth's or other surface occurs. The surface—angle—quotient is applied to actinometers and their use and properties. Nocturnal effective radiations at Frankfurt are expressed by the E.R.T.D. and their dependence on vapour pressure near the ground given for different radiating conditions in the atmosphere. A comparison of the Frankfurt observations with those of Ångström in Algeria and California show differences depending partly on the vapour pressure. The Frankfurt observations are then compared with the theory of the outgoing radiation to a polytrope atmosphere and equations give (1) the absorption of the atmosphere for all E.R.T.D. at a fixed temperature gradient and (2) differences of grey absorption depending upon conical angle tested. These show that for long-wave radiation at earth temperature the atmosphere is not grey, confirming Ångström's view. Consideration of a non-grey polytrope atmosphere leads to quantitative results regarding absorption across the spectrum. R. S. R.

3497. Variation of Atmospheric Radiation Temperature and its Dependence on the Composition of the Atmosphere. A. Ångström. *Gerlands Beitr. z. Geophys.* 21. 2–3. *pp.* 145–161, 1929.

The author reviews fully earlier work on the subject, particularly with reference to the absorption bands of oxygen and water vapour and the dependence of ozone formation on solar radiation and α- or β-rays. He compares the variation of radiation in the atmosphere during the night with the similar curves observed during total solar eclipses. Water-vapour changes are considered inadequate to provide an explanation for this variation. He inclines to the view that for possible radiations received through the atmosphere from space down to a height of 40 km., ozone is dissociated by day, but at night the amount of ozone increases and reaches a maximum 2 to 4 hours after sunset, when this outgoing radiation is a maximum. Experiments by Chalonge on the absorption of ultra-violet light by ozone during the night confirm this view, since he found at that part of the night an equivalent ozone layer 3·17 mm. in thickness instead of the day value of 2·30 mm. R. S. R.

3498. Acceleration of Air Masses in Atmospheric Movements. L. Petitjean. *Comptes Rendus*, 188. *pp.* 1688–1690, *June* 24, 1929.

Thermodynamic relations are applied to establish the acceleration of a mass of moving air and the equations obtained are applied to the cases of warm and cold fronts, the zone between two cold fronts and to the descent of cold air. R. S. R.

3499. Determination from a Large Distance of the Geographical Position and Speed of Meteorological Discontinuities or Perturbations by the Atmospherics they Emit. J. Lugeon. *Comptes Rendus*, 188. *pp.* 1690–1692, *June* 28, 1929.

The author distinguishes local atmospherics which are heard for short distances only and whose direction cannot be traced by a radiogoniometer, from distant atmospherics often many thousand kilometres away, located on cold fronts and with their direction recorded. The range rises to a maximum after sunset, when the sun's rays can no longer reach the Heaviside layer. By a study of records over 550 days at Zurich, the author traces from the form of the record the location of the front, and from its intensity an indication of the loss or gain of energy at the front. Readings on successive days will give the speed and direction of travel of the front. R. S. R.

3500. Distribution of Terrestrial Radiation. G. C. Simpson. *Roy. Meteorolog. Soc., Mem.* 3. *pp.* 53–78, *April,* 1929.

The present work utilises the method previously outlined and utilised in earlier work, for the calculation of the distribution of incoming and outgoing radiation at different parts of the earth at different times of the year, and in this way to obtain a picture of the radiation balance both in time and space. The geographical distribution of incoming and outgoing radiation during January and July is determined and illustrated by means of maps, whilst the amounts of the incoming and outgoing radiation for each 10° zone of latitude are calculated for each month of the year. It is shown that in the two months of June and December the whole region from the Pole which has summer, to more than 10° beyond the equator, receives more heat from the sun than it radiates into space; while the remainder of the earth emits more radiation than it receives. During the equinoctial months, September and March, the region which receives more heat than it emits is approximately central. Curves showing the intensity of net radiation with latitude for the period December to June show a marked similarity to those recording the same factor from June to December, and considering the great difference between the two hemispheres as regards the distribution of land and sea this symmetry is remarkable. It is further shown that the total outgoing radiation from the earth as a whole during the year averages $0 \cdot 548 \times 2\pi r^2$ cal. per min., whilst the total effective solar radiation averages $0 \cdot 536 \times 2\pi r^2$ cal. per min., a difference of only 2 %. The agreement is very good, considering the uncertainty of many of the data used. The result indicates great uniformity in the intensity of the outgoing radiation from the earth, both in time and space. Except, as mentioned above, for small uncertain irregularities, the total outgoing terrestrial radiation just balances the incoming solar radiation at all periods of the year. The paper concludes with numerous tables, including temperature, clouds and radiation at all times during the year. S. G. B.

3501. Ocean Movements. Newtonian Potential of the Atmosphere in Cylindrical Coordinates. M. Brillouin. *Comptes Rendus,* 188. *pp.* 1637–1640, *June* 24, 1929.

The use of cylindrical coordinates in forming a dynamical theory of ocean movements has been found advantageous except in that part of the problem which takes account of the Newtonian potential of the atmospheric cushion. A transformation is explained which enables the author to overcome this difficulty. G. E. A.

3502. Use of Galitzin Pendulums for Records of Near Earthquakes. B. Gutenberg. *Gerlands Beitr. z. Geophys.* 22. 1–2. *pp.* 100–102, 1929.

A method is described in which by a special adjustment of the Galitzin pendulum earth waves produced by quarry explorations are recorded at a distance of 70 km. at the Taunus Observatory. By this adjustment waves not previously shown by the Mainka pendulum, a type more generally used for near earthquakes, are recorded by the Galitzin pendulum. R. S. R.

3503. New Type of Seismometer. F. Wenner. *Bureau of Standards, J. of Research,* 2. *pp.* 963–999, *May,* 1929.

The theory of electromagnetic damping and magnification is discussed in a more general way than that given by Galitzin, and methods which will give proper electromagnetic damping. The general seismometer equation, a linear differential equation of the fourth order, is solved for the case of a sustained harmonic displacement of the ground. A general design is then developed for a seismometer to give a specified performance. This instrument can be of small size, simple construction and requires no special magnets for producing proper damping. A photograph of such an experimental seismometer is given together with parts of a few records obtained with it. R. S. R.

3504. Tilting of the Surface of a Semi-Infinite Solid due to Internal Nuclei of Strain. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 1–14, *June*, 1929.

Recently observations have been commenced on the deformation of the earth's surface in earthquake regions, in the hope of obtaining information as to the nature of the internal strains to which earthquakes are due. The author's object is to study mathematically the relation between certain forms of internal strain and the tilt of the surface produced by them, and in the present paper he deals with multiplet nuclei of strain of the compressional or dilatational type. Distortional strains can be dealt with in a similar way. Expressions are found for the surface tilt, in different positions, due to singlet, doublet, and quadruplet nuclei; and curves are given showing the tilt of the surface above the nucleus for a number of different conditions. The distribution of the tilt about the centre is shown to have a different form for each type of multiplet. Other forms of strain are to be investigated. H. N. A.

3505. Shallow Water Waves due to Subaqueous Shocks. K. Sezawa. *Tyoko Univ. Earthquake Research Inst., Bull.* 7. *pp.* 15–40, *June*, 1929. *In English.*

Four cases are considered mathematically: (i) where the effect of the inertia of the water on the compressional disturbance (assumed to be at the bottom) is negligible and the depth of the water very small; (ii) as in (i) but the depth not small; (iii) as in (ii) but the effect of inertia not neglected; (iv) where the disturbance occurs at an intermediate depth. In (i) both horizontal and vertical displacements are so related to the period of disturbances and depth that given the depth, period and amplitude the magnitude of the disturbance is deducible. In (ii) the velocity of propagation is not constant. In (iii) this velocity is not affected by the inertia. In (iv) the displacement depends both on the depth of origin of the disturbance and of the sea. [See Abstract 2390 (1929).] C. A. S.

3506. Generation of Rayleigh Waves from an Internal Source of Multiplet Type. K. Sezawa and G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 41–64, *June*, 1929. *In English.*

In a previous paper Sezawa has dealt with an internal source of doublet-type [see Abstract 2389 (1929).] The mathematical processes employed are similar to those employed by Lamb in connection with the generation of Rayleigh waves from an internal singlet. The results obtained are illustrated in a series of figures, which show the relations between the displacements due to the Rayleigh waves for different angles of azimuth, and for different distances from the epicentre. In the case of doublets the figures cover the cases of a horizontal doublet, an inclined doublet and a vertical doublet. Figures are also given for quadruplets in different positions. H. N. A.

3507. Measurement of Movements of a Building under Quiet Conditions. M. Ishimoto and R. Takahasi. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 175–184, *June,* 1929. *In French.*

Microseismographs for recording horizontal and vertical components of movements of period of one second or less and of amplitude of one micron are described, and the results given of their use in investigating the movements of the Earthquake Research Institute, a three-storied building of concrete with iron framework. Four such microseismographs, two of each kind, were placed in various positions. Movements of the building as a whole as though it were attached to the earth and due to irregular movements thereof were clearly detected, and are regarded as similar in mechanism to seiches. Less definite are movements due to elastic vibration of the building. C. A. S.

3508. Theory of Dilatation. New Theory of Origin and Activity of Endogenous Forces. J. Moscheles. *Geolog. Mag.* 66. *pp.* 260–268, *June,* 1929.

An essay review of B. Lindemann's book, *Kettengebirge, kontinentale Zerspaltung und Erdexpansion.* The theory is that the earth's crust is in a state of dilatation caused by increasing calorification due to radioactivity. It is pointed out that there has been steady increase in geosynclines (folded areas) throughout geological time, and that the maxima of volcanic activity are separated by shortening intervals (Keweenan 500, Permian 200, Tertiary 25 million years ago). The slow accumulation of heat weakens the overlying crust and so causes periodical explosions due primarily to the hot gases of the interior under such compression that they possess a rigidity greater than that of cold steel. There are in the globe two main levels: (*a*) of the floor of the ocean, depth about 12,000 ft.—of sima; (*b*) the "Archæan shield," 600 ft. above sea-level—of sial blocks, covered partly but always unconformably by sediments; and (*c*) elongated zones, rift valleys and folded mountain zones, showing great activity of endogenous forces and extremely labile, the areas of which have increased throughout geological time. Thus there is a "gradual shattering of the existing sial blocks." A fissure first forms a rift valley, any apparent downfaulting being due to blockslides from its sides. This may develop into a drifting apart of continents, or to a less extent. As it widens there is an uprising in the centre (**W**-shaped geosyncline), followed later possibly by a central depression (**M**-shaped geosyncline). Various possibilities are worked out in detail. C. A. S.

ASTROPHYSICS.

3509. Thermal Excitation of Atoms in the Reversing Layer of the Sun. A. Unsöld. *Mt. Wilson Observat. Contrib.* No. 379. *Astrophys. J.* 69. *pp.* 322–329, *June,* 1929.

Adams and Russell have shown that the distribution of atoms in higher quantum states does not in general agree with Boltzmann's law. In order to test Boltzmann's relation for a single star, the number of atoms multiplied by the corresponding oscillatory power, *f*, for two states of the same atom may be determined by the line-contour method. The unknown *f*'s can be eliminated by using two similar atoms, for instance, Ca^+ and Ba^+, which may be assumed to have practically the same transition probabilities. Photometric measures of the infra-red $3^2D - 4^2P$ lines of Ca^+ and of the corresponding Ba^+ lines are described. The effect of the finite resolving power of the grating is investigated. Discussion of the observations indicates that for excitation potentials up to 1·7 volts Boltzmann's relation holds within the accuracy of measurement. For the ratio of the oscillatory powers f_{DP}/f_{SP} the value 0·2–0·25 is obtained. An upper limit for the transition probability of the forbidden Ca^+ lines $4^2S - 3^2D$ is derived. The lifetime of the metastable 3^2D state must be $> 10^{-2}$ sec. AUTHOR.

3510. Theory of the Magnetic Field associated with Sun-Spots. R. Gunn. *Astrophys. J.* 69. *pp.* 287–292, *May*, 1929.

Theory of sun-spot magnetic fields based on the drift of ions produced by ions spiralling around a non-homogeneous magnetic field. The Hale-Bjerknes theory is retained almost completely. It is shown that the small initial symmetrical magnet field produces currents in such a direction that regeneration is possible, and that the currents flowing in the steady state are ample to account for the observed fields. The square of the computed fields are found to be proportional to a logarithmic function of the radius of the spot and the depth of the conducting layer. AUTHOR.

3511. Sun's Absolute Velocity. J. M. Mohr. *Comptes Rendus*, 188. *pp.* 1537–1539, *June* 10, 1929.

For the sun's direction and velocity, the values adopted are, $\alpha = 270°$, $\delta = +30°$, and $v = 20$ km.; the author inquires into the correspondence of this velocity, with statistics from the absolute motions of dwarf stars of which the sun is one [see Abstract 1486 (1929)]. For the giants 20 km. holds good for the sun's mean motion; but for F-type it is 34·8; for G, 41·3; for K, 40·2; and for M, 29·9 km.; for all these types together it is 37·0 km., or nearly double its adopted motion. Taking this value and the above coordinates of the apex, he finds for the absolute velocity of any star the relation: $\nu = \sqrt{\xi^2 + (\eta - 35)^2 + (\zeta + 20^2)}$, where ξ, η and ζ are the components of the star's absolute velocity, and he applies it to 519 G stars. The absolute velocity distribution does not correspond with the Adams-Stromberg-Joy law, but does accord well with the Maxwell law for giants (except between the limits 30–40 km.), and not so well for the dwarfs, though the maximum of the theoretical curve corresponds very nearly with that of the observed, and the number of stars having large absolute velocity corresponds better with the number of stars observed. A. S. D. M.

3512. Euclidean Approximations to Einsteinian Motion in the Solar Field. G. O. James. *Astron. J.* 39. *pp.* 111–114, *May* 25, 1929.

Employing Palatini's form of metric $ds^2 = V^2dt^2 - H^2dl_0^2$, approximations are readily derived for the motion of a planet and of light in a gravitational field. The close analogy between Einstein's geodesic condition and Hamilton's principle is the basis of the method employed, and the results are derived by writing Palatini's metric in the form $ds^2 = (V^2 - H^2v^2)\, dt^2$ with $v^2 = dl_0^2/dt^2$ and $L \equiv (V^2 - H^2v^2)^{\frac{1}{2}}$. J. S. G. T.

3513. Astronomical Implications of De Sitter's Universe. R. C. Tolman. *Astrophys. J.* 69. *pp.* 245–274, *May*, 1929.

Using Eddington's form of line element, exact expressions are derived for the motion of particles and light rays in de Sitter's universe, and for the Doppler effect in terms of distances and velocities, or in terms of distances and orbital parameters. The Doppler effect at perihelion and the ranges of distance and time during which an approaching source would produce a reversed positive Doppler effect are discussed. A general review leads to the conclusion that the de Sitter line-element does not afford a simple and evident explanation of present knowledge of the distribution, distances and Doppler effect for the extra-galactic nebulæ. J. S. G. T.

3514. Relativity and the Earth's Rotation. G. Giorgi and A. Cabras. *Accad. Lincei, Atti*, 9. *pp.* 513–517, *April* 7, 1929.

Referring to Nordman's assertion that the proofs of the earth's rotation are purely nominal, the authors prove on relativistic principles that the earth is endowed with a rotation with respect to the local axes of inertia. Among the proofs of Galileo, those are really valid which are based upon considerations of symmetry in the distribution of velocity with regard to the totality of the stars; and the experiment of heavy bodies falling from a tower. To these must be added Foucault's experiment, the gyroscopic experiments, and Michelson and Gale's experiment. The argument from the velocity of light corroborates that of Galileo. E. E. F. d'A.

3515. Tisserand's Desideratum and the Theory of the Shapes of Planets. R. Wavre. *Comptes Rendus*, 188. *pp.* 1657–1660, *June* 24, 1929.

It has been pointed out by Tisserand (*Traité de Mécanique celeste*, p. 317) that the expansion of $1/r$ occurring in planetary theory, r denoting a length, in a series of Legendre coefficients is legitimate only when the series is convergent. Laplace and Poincaré have not always strictly observed this condition in their work. A rigorous treatment of the problem of planetary shapes, based upon an analysis which overcomes this difficulty of expansion, and which yields the equations due to Clairaut, Clairaut–Radau and Poincaré, is presented. J. S. G. T.

3516. Determination of Time. J. Aramburo. *Univ. Nac. La Plata, Estudio Ciencias, No.* 87. [81 *pp.*], *Feb.* 1929. *In Spanish.*

A detailed and tabulated paper. The determination of time with a Gautier altazimuth. The same with a Wanschaff zenithal telescope; Doellens' method. The latitude of the Gautier altazimuth determined by the Horrebow-Talcott method. The latitude of the Wanschaff zenithal telescope determined by the same method. A. D.

3517. Astronomical Photographic Intensities. L. Genovese. *Accad. Lincei, Atti*, 9 *pp.* 640–644, *April* 21, 1929.

A comparison between the photographic intensities of various zones in the Astrographic Catalogue. A. D.

3518. Formation of Absorption Lines. A. S. Eddington. *Roy. Astron. Soc., M.N.* 89. *pp.* 620–636, *May*, 1929.

The theoretical calculation of intensities and contours of absorption lines in stellar spectra consists of two parts: (1) the determination of the coefficients of absorption and emission of the material, according to the theories of atomic physics; (2) a study of the outward flow of radiation through an atmosphere composed of such material. Recent advance has been chiefly in the first part, especially owing to the formula of Unsöld; but this does not affect the second part, and the solution given by the writer in *Internal Constitution of the Stars* has not been superseded by anything published since. Therefore, it is here stated again, with the elaborations and illustrations that are called for, in view of the extended range of problems now attracting interest. The general equations are first set forth, and the solution for a standard case; then the more important deviations from this case are considered separately. It is shown that, so far as the main part of the absorption line is concerned, line-intensity cannot be determined except in unusually simple spectra where there is no interlocking. The absorption coefficient has very little direct effect in determining the strength of a line, and although its indirect effect is doubtless important, it is incalculable. It is pointed out that several implicit assumptions are involved in Unsöld's theory, if it permits the intensities of the wings of spectral lines to be calculated without regard to this interlocking, which affects the intensities of the more central parts of the lines. An adequate examination of these assumptions, to see if they are in accordance with present physical theory or experiment, does not seem to have been made. M. A. E.

3519. Determination of Maximum Intensities of Stellar Absorption Lines. Cecilia H. Payne. *Harvard Coll. Obs., Bull. No.* 867. *pp.* 1–7, *May* 1, 1929.

A review of the present knowledge of the maximum of stellar absorption lines. The author gives a list of authorities for the study, during the last four years, of spectral lines which are not expressed in arbitrary units but by Unsöld's formulæ [see Abstracts 286 and 1200 (1928)] for determining the shape of a line contour in terms of one constant NH. By Milne's new theory the atmosphere is taken as in layers; the optical depth (τ) is defined as corresponding to the intensity ratio (r); and the maxima are determined *for constant r*, presupposing the measurement of contour along spectral sequence. For these the possible lines are those of hydrogen and calcium. Tables are given: (*a*) of half-breadths of lines with $r = 0{\cdot}83$—the shift of maximum with r is probably greater for hydrogen than for any other element, but is inappreciable for calcium, and the observed maximum shift is three-tenths of a spectral subdivision, thus setting the limit of error for the adopted maxima between the determinations by contour and those by estimates of intensity or of depths; (*b*) of log NH and measured depths of the K-line—to a first approximation all lines are similar and this table serves for converting measured depths into numbers of effective atoms; (*c*) of percentage light loss of spectral classes, of comparison of maxima, and of adopted maxima of spectral lines. A. S. D. M.

3520. Observations Bearing on Milne's Generalisation of Saha's Theory. Cecilia H. Payne. *Harvard Coll. Obs., Bull. No.* 867. *pp.* 7–14, *May* 1, 1929.

A comparison between theory and observation, confined to the total pressure (p), the optical depth (τ) corresponding to the level considered, and the partial electron pressure (P_0) at that level corresponding to the maximum of the line in the spectral sequence. The author states five problems considered by Milne and a table of their formulæ, and summarises the application of the theory to the observations. Milne's assumption that κ is constant leads, for all the problems, to $\tau = \bar{\kappa} \,.\, p \,.\, g^{-1}$. Kramer's assumption is that $\kappa = aP_0(kT)^{-9/2}$. Tables are given on the basis of these two assumptions and two tests are given to discriminate between them; namely that neutral atoms subordinate lines with excitation potential less than one-third ionisation potentials should have no maxima, and that lines should be strengthened from faint to bright stars on either side of their maximum in the spectra sequence; if κ varies with P. On both tests Kramer's assumpion is physically preferable. Milne has derived the theoretical value, $\alpha = 2\cdot83 \times 10^{-57} f$, but it is shown by a table of $\bar{\kappa}$ and α from observed values that, except for hydrogen, all are larger than 10^{-57}, sometimes 10^9 larger. Invocation of another mechanism besides "free-free" encounters to control the opacity is inadequate to remove such a discrepancy. [See Abstracts 1113 and 1114 (1929).] A. S. D. M.

3521. Physical Interpretation of Spectroheliograms. A. Unsöld. *Astrophys. J.* 69. *pp.* 275–286, *May*, 1929.

The author applies the theory of radiative equilibrium to a stratified atmosphere in which occur resonance scattering and collision, the latter producing absorption. He considered a schematic solar atmosphere of two layers (I and II) above the photosphere (I_0), and gives contours for change in line intensity and of integration constants in these layers. For calcium he takes the broad H_1 and K_1 lines as originating at a depth where collisions are not negligible ($\lambda_1 = 0\cdot088$ and $\omega_1 = 0\cdot2$); above this, in a transition layer, abnormally strong collision excitation takes place very easily and is connected [see Abstract 2093 (1928)] with very rapid change in density between the reversing layer and chromosphere, "aerodynamic" perturbations occurring near spots and faculæ; in the outer chromosphere, collisions are unimportant and there is strong absorption (H_3, K_3). The innermost parts of a line correspond to the highest layers, the outer to deeper; the form of the outermost wings, where collisions are unimportant, is determined by the number of atoms in the whole atmosphere. Quantitatively the H_2 and K_2 maxima rise only about 6 % above the brightness of the surrounding minima and the visual impression is much exaggerated by contrast. On the sun when quiet the deviations are small; near disturbed regions the middle intensity of H_3 and K_3 is about 23 % smaller than H_2 and K_2 maxima. He finds H_α essentially different. H_α never becomes narrower than normal, but, in disturbed regions, broader. He attributes the Evershed effect and limb-centre displacements to elementary facts of physiological optics. A. S. D. M.

3522. Energy Spectra of the Stars. C. G. Abbot. *Astrophys. J.* 69. *pp.* 293–311, *May*, 1929.

A sensitive radiometer.—Fragments of flies' wings are used as vanes, and the exceptionally light suspension is sealed into a fused-quartz tube, optically figured opposite the vanes and mirror and filled with hydrogen at 0·23-mm. pressure. The description includes various data regarding the weights, moments of inertia, advantages of hydrogen as compared with air, and sensitiveness of the apparatus.

Radiometric observations of stars.—The instrument was used to measure the distribution of energy in stellar spectra formed by a 60° flint-glass prism at the coudé focus of the Mount Wilson 100-inch telescope. The deflections were observed at a scale distance of 6 m. by a special reading device, with a probable error of $2''\cdot8$ in the rotation of the suspension. This figure includes errors of reading and those due to all other accidental causes. Spectral energy-curves for eighteen stars and two planets were observed, sometimes on two or three nights. The faintest star measured is of magnitude 3·8. A comparison of the results with those obtained by the author in 1923 with a larger radiometer shows in general an agreement as good as could be expected from the accuracy of the observations. AUTHOR.

3523. Systematic Errors in the Draper Catalogue. A. Bemporad and L. Genovese. *Accad. Lincei, Atti,* 9. *pp.* 682–686, *May* 5, 1929.

These errors are smaller than in other catalogues. The subject is worked out. A. D.

3524. Algol *e* and the Velocity of Light. M. la Rosa. *Accad. Lincei, Atti,* 9. *pp.* 686–692, *May* 3, 1929.

The phenomena of Algol *e*, considered as an aggregate of three bodies (discussed in detail), furnish striking confirmation of the author's ballistic theory of light, that the velocity of light is influenced by the motion of the source. A. D.

3525. Light Curve and Period of W Ursae Majoris. G. Viola. *Accad. Lincei, Atti,* 9. *pp.* 743–747, *May* 5, 1929.

Supports the slight variability of the four-hour period of this star observed by A. Bemporad. E. E. F. d'A.

3526. Constancy of Light Velocity. P. Salet. *Comptes Rendus,* 188. *pp.* 1539–1540, *June* 10, 1929.

An inquiry as to whether the velocity of light is independent of the attraction of the source as well as of dispersion in space or of the motion of the source. In the case of Newton's law, light leaving a star with velocity c takes on a velocity slightly inferior, about 0·7 km./sec. for the sun's type, but changing with spectral type. Spectroscopic doubles furnish a method of obtaining evidence as to this feeble variation through the dislocation between the light curves of the two components; the dislocation increasing with the distance is of the order of an hour for 3rd magnitude stars of types A_0 to A_5. This investigation has not yet been made, and requires new observations for the point where the radial velocity is annulled in double stars of differing spectra; the method suggested applies best to stars distant from each other as well as distant from the earth. A. S. D. M.

3527. Multiple Solutions in Orbit Determinations. H. C. Plummer. *Roy. Astron. Soc., M.N.* 89. *pp.* 682–687, *June,* 1929.

In the orbit of a planet let S, E, P denote the positions of sun, earth and planet and let $SE = R$, $SP = \sigma$, $EP = \rho$, $SPE = z$, $SEP = 180 - \delta$. The author derives the expression $\sin^4 z = \sin^3 \delta(\sin z - b \sin (\delta - z)]$, and his object is to examine the nature of the appropriate solution. This he does by considering the intersections of the line: $\sin^3 \delta[y(1 + b \cos \delta) - bx \sin \delta] = 1$, with the curve whose polar equation is $r \sin^4 \theta = 1$. This evidently consists of two branches symmetrically separated by the axis of x, and the form of the upper branch shows that a straight line will cut it at one or at three points. For the criterion of a single valid solution he finds $b(b - 3 \cos \delta) < 0$, whether b is positive or negative. For the polar equation giving the position of the planet $(\sigma, \delta - z)$, the pole being the sun and the radius vector of the earth the initial line, he finds $4 = 3\sigma \cos (\delta - z)R^{-1} + R^3\sigma^{-3}$, which is the *limiting curve* of Charlier, which plays a part in the discrimination between a single and double solution; and also the equation $4 = 3R \cos (\delta - z)\sigma^{-1} + \sigma^3 R^{-3}$, which defines the locus of the planet in the same polar coordinates $(\sigma, \delta - z)$, and is the inverse with respect to the circle $\sigma = R$, being the *singular* curve of Charlier. Two apparently valid solutions of the problem coincide when the planet lies on either of the two curves. A. S. D. M.

3528. Number of Stars of Different Magnitudes in the Hyderabad Astrographic Catalogue. Fifth Paper. Zone − 21°. T. P. Bhaskaran. *Roy. Astron. Soc., M.N.* 89. *pp.* 678–682, *June,* 1929.

A discussion of the number of stars of different photographic magnitudes in the four Hyderabad zones Dec. −17° to −20° was published in a series of papers in the Monthly Notices. The three zones −21° to 23°, which were subsequently undertaken at Hyderabad, are now nearly completed, and counts of magnitudes have been made in the zone −21°. This material is discussed in the present note. A value is deduced for the galactic condensation, and after correcting for this the residuals are analysed harmonically. Similar counts are in progress for the remaining two zones. M. A. E.

3529. Spectrum of B.D. + 11° 4673. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 381. *Astrophys. J.* 69. *pp.* 330–378, *June,* 1929.

Forty-six spectrograms have been obtained from 1919 to 1928. More than 160 bright lines have been observed, of which nearly all are variable in intensity and position, and some are variable in structure. The elements whose lines were studied in some detail are H, He, Fe, Al, N and Si; other elements represented by bright lines are Ti, Cr, Mg, C and Sc. A number of lines were found to be accompanied by dark companions. The displacements of lines of H, He and Fe are found to vary in a cycle of 800 days, with a difference in phase between the oscillations of hydrogen and helium lines of 160 days. The maximum ionisation is apparently slightly in excess of 33 volts. Numerous tables are given of the lines found. F. S.

3530. Dwarf Nature of Spectroscopic Binaries. E. A. Kreiken. *Roy. Astron. Soc., M.N.* 89. *pp.* 589–609, *April,* 1929.

Spectroscopic binaries are usually very bright, and therefore it is generally assumed that they are giants. But this has never been proved, and evidence is here brought forward to show that they are dwarfs. It is argued that the value of sin i generally used is too small, and that the true value is 0·927. When this is used, the masses of these binaries do not agree any longer with those of giants, but with those of the main sequence of dwarfs. Further, the distances derived from Eddington's mass-luminosity relation have been compared with those obtained from trigonometrical and spectroscopic parallaxes, and it is found that the theoretical distances derived from the dwarf masses agree perfectly. M. A. E.

3531. The Pleiades. E. Hertzsprung. *Roy. Astron. Soc., M.N.* 89. *pp.* 660–678, *June,* 1929.

Recent investigations of the Pleiades, made at Leiden and in part unpublished, are the subject of this lecture. Old photographs of the cluster, taken at Leiden and elsewhere, have been compared with new plates, and the physical members of the cluster are distinguished from other stars in the same field by their similar proper motions. Their frequency in different magnitudes and their spatial distribution in the cluster are shown in diagrams. Small differences between the individual proper motions were sought for, since these might be expected for various reasons, but so far none can be found. Fairly accurate colour-equivalents are known for Pleiades stars, down to the 14th magnitude, and it is found that the same relation between colour and brightness obtains as with naked-eye stars, but the relation of colour and spectral class is less clear. This indicates that the spectral classification of Harvard does not correspond with a homogeneous colour-scale, as is sometimes assumed. All physical Pleiades so far known belong to the main series, and there are no yellow giants or white dwarfs. Several methods of determining parallax are suggested. The question whether the nebulosity in the group shares the motion of the stars ought soon to be settled simply by comparing old and new photographs stereoscopically. Among the observations now most urgently required are examination of stars fainter than 14th magnitude for spectra, colour, and possible duplicity, and accurate determinations of angular distances between the outer stars, with the object, later on, of measuring the apparent shrinking of the cluster as it recedes from us. M. A. E.

3532. Forms and Evolution of Terrestrial Mass before Spheroidal Condensation. E. Belot. *Comptes Rendus,* 188. *pp.* 1481–1484, *June* 3, 1929.

From the dualistic cosmogonic theory, the author deduces the evolution of the earth's mass. He gives the size, flattening, rotation and density of the proto-sun, which received on its northern hemisphere a shock producing pulsation and causing the expulsion of rings of which the earth is the 8th. He gives its constituents, times and other particulars of its motions. He describes this ring as condensing into a tube-eddy, coaxial with the earth's axis and the condensation of this longitudinally into a spheroid; the northern and southern portions converging to the centre and throwing out rings of which the first formed the moon. A. S. D. M.

3533. Correction of Orbits by Means of Coordinates Referred to the Plane of Motion. T. Banachiewicz. *Comptes Rendus,* 188. *pp.* 1484–1485, *June* 3, 1929.

By means of his formulæ of a new kind involving the ecliptic elements, ω, i, Ω, and the obliquity ϵ of the ecliptic, the author determines the five cosines a, by means of relations expressed in matrices-cracovians; he computes the six derived quantities $b_i = \frac{\partial \bar{x}}{\partial e_i}$, $b_{i+3} = \frac{\partial \bar{y}}{\partial e_i}$, $(i = 1, 2, 3)$; and then the five quantities, c, and the quantities $\cos \delta' d\alpha'$, $d\delta'$, also by relations expressed in matrices-cracovians. The advantage of this method is that it is not necessary to determine the auxiliary trigonometric values δ_1, i_1, ω_1 (elements referred to the equator) and α'. [See Abstract 1127, (1929).] A. S. D. M.

3534. Spectroscopic Observations of R Virginis. P. W. Merrill and A. H. Joy. *Mt. Wilson Observat. Contrib. No.* 382. *Astrophys. J.* 69. *pp.* 379–385, *June,* 1929.

A mean light-curve for the interval 1920–1928 is given. The spectral type is M4*e* at maximum and M8 near minimum. The spectroscopic absolute magnitude at maximum is $-0 \cdot 6$. The curve of velocities derived from the absorption lines resembles the light-curve, but that from the emission lines is entirely different. The bright hydrogen lines have their greatest intensity near maximum light, and their displacements behave in the same general manner as in *o* Ceti, but there are interesting differences between the two stars. The low-temperature lines of iron, magnesium and other elements, observed in emission in *o* Ceti, are weak or absent in R Virginis. AUTHORS.

LIGHT.

3535. Penetration of Radiation in Water. C. Fabry. *Rev. d'Optique*, 8. *pp.* 218–222, *May*, 1929.

The various factors involved in the extinction of a beam of light through a large bulk of water are first considered, *viz.*, true absorption, diffusion by water molecules, diffusion by very small corpuscles of colloidal matter and diffusion and absorption by large particles in suspension. Two recent memoirs are discussed, *viz.*, Hulburt's " Penetration of Ultraviolet Light into Pure Water and Sea Water " [see Abstract 2976 (1928)], and Hibben's " The Transmission of Light through Liquids " [see Abstract 510B (1929)], and the conclusion is drawn that the data furnished above will be of great value in marine biology. H. H. Ho.

3536. Absorption Curves of Non-Homogeneous Radiation. H. Hellmann. *Phys. Zeits.* 30. *pp.* 357–360, *June* 1, 1929.

Calculates the absorption curves for light incident from all sides in a space limited by plane surfaces. This is to supply a handy method for discussing the absorption of cosmic radiation, as in the experiments of Millikan and Regener. E. E. F. d'A.

3537. Cause of Colour of Micas. T. Yoshimura. *Inst. Phys. and Chem. Research, Sci. Papers* (*Supplement*), 11. *pp.* 1–4, *June* 26, 1929.

The author has studied spectroscopically the transmission curves of various grades of coloured micas and of cobalt glass. For the latter the absorption takes place in characteristic bands due to the molecules or complex molecules of cobalt existing as a chemical constituent of the glass. For mica, however, there are no selective bands but only the end absorption. It is concluded that the colour of coloured mica is to be attributed to certain dispersed particles contained in these micas in a colloidal state. J. W. T. W.

3538. Reflective Power of Quartz. E. Blouin and M. Duffieux. *Rev. d'Optique*, 8. *pp.* 214–217, *May*, 1929.

In this paper a special photometer with diffusing screen is described which has enabled the exact verification of Fresnel's law for quartz surfaces perpendicular to the axis for normal incidence. H. H. Ho.

3539. Spectrum, Colour and Polarisation of the Light of the Night Sky. J. Dufay. *J. de Physique et le Radium*, 10. *pp.* 219–240, *June*, 1929.

The light of the night sky has been investigated quantitatively by means of a quartz spectrograph and calibrated photographic plates. It is shown that its continuous spectrum from 4800 to 3000 Å. closely resembles that of the sun. The green auroral ray is very prominent and produces between 4960 and 6000 Å. 3/5ths of the illumination (as measured by an orthochromatic plate) produced by the continuous spectrum. The ratio of the corresponding energies is 3 : 4, while for visual observations the auroral ray produces about 1/10th of the apparent illumination. The colour of the night sky (apart from the auroral ray) is much nearer that of sunlight than is that of the blue sky, but is relatively stronger in the violet and red. It is to an extent of about 3 % (*i.e.*, considerably less than the zodiacal light) polarised, the plane of polarisation always passing through the sun. The light thus consists of the permanent aurora, light from the stars, that diffused by the atmosphere, and the zodiacal light; but all these only account for about half the total amount, the source of the remainder is still to be discovered. C. A. S.

3540. Prism Refractometry and Certain Goniometrical Requirements for Precision. L. W. Tilton. *Bureau of Standards, J. of Research*, 2. *pp*. 909–930, *May*, 1929.

A review is given first of previous measurements of the refractive index to the 6th figure. The methods discussed are those of (1) minimum deviation, (2) grazing incidence, and (3) Abbé's autocollimating method, of which (1) is best because of its greater sensitiveness and relative ease of computation. Various means of temperature control are considered, the errors due to the divided circle and the use of multiple microscopes to minimise them, micrometer errors, and the non-constant residual mechanical strains in the instrument. R. S. R.

3541. Ploix Universal Stereoscope. Ménétrat. *Soc. Franç. Phot. et Ciné., Bull.* 71. *pp*. 105–108, *April*, 1929.

Describes the construction of the Ploix universal stereoscope, developed during the war for the examination of large aerial survey photographs. The stereoscope itself consists of the usual Helmholtz four-mirror type viewed through field-glasses for magnifying purposes, the metal container of the mirrors and field-glasses being capable of both horizontal and vertical motion. The print-carriers are arranged to have horizontal, vertical and circular motions operated from a distance by racks and pinions. The whole is mounted on rails on the inside of the lid of the containing box, and each print-carrier has, therefore, separate longitudinal motion. This is especially useful, allowing a comparison to be made of photographs of different scales. R. C. F.

3542. Improved Balloon Theodolite. Kölzer. *Zeits. f. Instrumentenk*, 49. *pp*. 292–295, *June*, 1929.

The features of the construction of the instrument are given in detail. The telescope has a magnification of 20, and a bright and large field of view. A yellow screen is used when viewing objects near the direction of the sun. A fixed lamp is used for illumination of the parts of the horizontal and vertical circles to be read at night, this being arranged so as not to interfere with the observer at the telescope. The advantages claimed for the instrument are described. R. S. R.

3543. Study of the Beams from Optical Apparatus. A. Blondel. *Comptes Rendus*, 188. *pp*. 1464–1467, *June* 3, 1929.

Describes two simple methods for direct measurement in the laboratory of beams from lighthouse optical systems, thereby eliminating photometric measurements at long distances. In the first method the rays from the optical system fall on a thin plano-convex lens of large diameter, the beam then converging on a diaphragm placed at the focal point of the lens. This diaphragm is pierced by a small circular hole and the light passing through falls on to the objective of a modified microscope, a magnified image thus being obtained in which the brightness is proportional to the illumination at the centre of the hole. The characteristic of the beam is obtained from readings taken for different angles of the optical system. The second method uses a spherical surface-silvered mirror with a radius of curvature equal to the focal length of the thin lens used in the first method, and the light from the optical system, which is placed at one side, is reflected on to the mirror from an unsilvered parallel-sided flat mirror. The diaphragm and microscope are used as before described. The errors in the two methods are calculated for specific cases, and it is shown that the results obtained, using a concave spherical mirror, are comparable with those obtained at large distances. A positive ocular is substituted for the ordinary negative ocular in the microscope, thereby allowing of observation of the brightness of the magnified real image of the hole in the diaphragm. R. C. F.

3544. Picture Formed by an Interferometer Objective. V. Ronchi. *Zeits. f. Physik*, 55. 11–12. *pp*. 717–724, 1929.

The properties of a circular grating for plane waves meeting it in a direction inclined to its axis are investigated. The shape of the image of a distant point source consisting of four luminous points connected by less luminous lines is examined. Practical tests made by the author and P. Stohr confirmed the theory. It is shown that away from the axis the objective interferometer is still achromatic and free from coma but astigmatic. Its use for photography is discussed. [See Abstracts 2567 (1926) and 93 (1927).] R. S. R.

3545. Particular Case of Diffraction of Solar Images at the Focus of a Telescope. M. Hamy. *Comptes Rendus*, 188. *pp*. 1526–1528, *June* 10, 1929.

This mathematical paper is preliminary to a study of the true value of the solar diameter, and contains an evaluation of an integral obtained in an investigation of the inequalities of brightness of a star disc.

H. H. Ho.

3546. Anomalous Dispersion of Sodium Vapour in the Visible and Ultra-Violet Parts of the Spectrum. A. Filippov and W. Prokofjew. *Zeits. f. Physik*, 56. 7–8. *pp*. 458–476, 1929.

By means of a special arrangement of the fluorspar interferometer, anomalous dispersion has been observed in the vicinity of the 25 doublets of the chief series of sodium and measured at 16. The general course of the dispersion curve has been investigated and the relative transition probabilities of the principal series of sodium have been determined. The observed values are in excellent agreement for the four first doublets with those calculated on the basis of wave mechanics. From the eleventh doublet onwards the transition probabilities conform to the expression $A_n = c/n^3$, where n is the chief quantum number. The number of the dispersion centres of all the sodium doublets from the second onwards amounts to 1·8 % of the number of dispersion centres of the first. From the theoretical values of the strength of the compensator oscillator f_1 for the first doublet, f is calculated for the continuous absorption at the limit of the principal series. H. H. Ho.

3547. Electric Double Refraction in Liquids. M. Iwatake. *Tohoku Univ. Technol. Reports*, 8. 3. *pp*. 121–132, 1929. *In English*.

Electric double refraction in nitrobenzene, ortho-nitrotoluol, pyridine and CS_2 studied by the photomicrographic method. CS_2 presents no anomalies, but the other three present phenomena which can be explained exactly like the chromatic polarisation of uniaxial crystals, assuming the optical axis to be coincident with the electric field. A. D.

3548. Talbot's Law. Fatigue and Non-Linearity in Photoelectric Cells. W. S. Stiles. *Phil. Mag.* 7. *pp.* 812–820, *May*, 1929.

The problem considered is that of the average response of a photoelectric cell, when illuminated with flickered light. The response of the cell is assumed to be subject to short-period fatigue and recovery. It is shown that, making the "natural" assumptions about the form of the fatigue and recovery curves, obedience to Talbot's law implies that the initial response of the cell is proportional to the light-intensity, and that in the case of non-linear cells the total amount of the fatigue is proportional to the square of the light-intensity. It is concluded that the analysis is valid for selenium cells, and in fact for all cases in which the average response to a periodically interrupted stimulus is in question. There are, however, difficulties in applying the results to human vision. [See Abstract 3030 (1929).] R. S. R.

3549. Kinematography by the "Kodacolor" Process. *Soc. Franç. Phot. et Ciné., Bull.* 71. *pp.* 101–104, *April*, 1929.

The "Kodacolor" process for amateur kinematography is essentially a refinement of the Berthon process first brought out in 1908. This latter process consists of coloured filters placed in the plane of the diaphragm, and a film in which the gelatine side is fluted and facing the optical system. The fluting or lenticular elements can be either spherical or cylindrical, and for the cylindrical elements the three-colour filters appear in the emulsion as parallel bands due to blue, green and red bands. Thus, a banded black and white film is obtained upon development and reversal, which is passed through an ordinary projector with a similar screen to that used in the actual photography of the object, thereby obtaining a coloured reproduction on the screen. In the "Kodacolor" process the refinements consist of improvements in film manufacture, and of equalising variations in manufacture by means of obscuring a certain fraction of the area of one or two of the coloured elements in the screen. This is done by means of a diaphragm supplied with each length of film, which is placed over the trichromatic screen before exposure. For the projection of the film a compensating lens is absolutely necessary in order to modify slightly the focal length of the projection objective, thus compensating for the difference between the focal length of the camera lens system and that for the projection lens system. The colours are then reproduced correctly. R. C. F.

3550. Kinematography on Stationary Films and at Extremely High Frequencies. C. Cranz and H. Schardin. *Zeits. f. Physik*, 56. 3–4. *pp.* 147–183, 1929.

An apparatus has been devised for kinematography on a stationary film with intervals between two pictures of anything between one-tenth and one-three-millionth part of a second. Examples are given of the use of the apparatus. F. J. W.

3551. New Method of Obtaining Photographic Positives Direct from the Exposed Negatives. R. Sesma. *Soc. Franç. Phot. et Ciné., Bull.* 71. *pp.* 108–110, *April*, 1929.

This new method, termed by the author "penetration method," consists of the normal development, washing in citric acid and then water, bleaching in a solution containing copper sulphate, and then redevelopment. The first development should be complete and yield an image as transparent as possible. Treatment with a desensitiser with a phenosafranine base produces better results. The development is stopped by soaking in a citric or acetic acid solution for some minutes and then washing in water. The negative is next soaked in a bath of copper sulphate, potassium bromide, chromic acid and water until there is only a faint reddish image left, after which it is thoroughly washed and dried. It must be perfectly dry before redevelopment, which can be done using a rapid developing bath rich in alkaline carbonate. Daylight can also be used for this second development, after which the product is fixed and washed as usual. The bleaching bath attacks parts of the gelatine and emulsion, hardening them so that on redevelopment the action only takes place where the developer can penetrate, hence the name. Excellent results have been obtained with films, but for plates and papers, although the method can be used for these, generally only mediocre results are obtained. R. C. F.

3552. Herschel Effect. A. P. H. Trivelli. *Kodak Research Lab. Comm. No.* 383. *Frank. Inst., J.* 207. *pp.* 765–797, *June*, 1929.

The author shows that what is now termed the Herschel effect is not the effect observed by Herschel. A better term would be the latent Herschel effect, for it is generally regarded now as the bleaching out of the latent image by red or infra-red radiation, whereas the true Herschel effect is an effect on the direct visible image. Schoen and Briggs, whose results are given, have shown that the Wratten filter No. 87 is the most suitable for the Herschel effect. The significance of the Herschel effect for the study of desensitisers of the latent image is discussed, and from experimental results it is shown that the Herschel effect shows the maximum effects determined by the amount of the first blue light exposure and the time of development. Finally, a quantitative expression for the Herschel effect is discussed. R. C. F.

3553. Delaying Action of Silver Ions on the Herschel Effect. Lüppo-Cramer. *Phot. Indust.* 27. *p.* 662, *June* 19, 1929.

Briefly discusses the action of silver ions on bromine ions in plates and papers, and shows that the removal of the bromine ions, necessary for the regression phenomenon, by means of the silver ions, stops the appearance of the Herschel effect. R. C. F.

3554. Nature of Sensitivity and the Latent Image. F. E. E. Germann and D. K. Shen. *J. Phys. Chem.* 33. *pp.* 864–872, *June*, 1929.

A study of the size and sensitivity of silver iodide, including a formula which yields emulsions of a large range of grain size. A luminescence phenomenon resulting from the contact of a spent developer with acids is investigated, and an explanation of it is given. E. E. F. d'A.

3555. Light Standard for Sensitometry. J. M. Eder. *Zeits. f. Wiss. Phot.* 26. *pp.* 373–374, *June*, 1929.

Briefly discusses certain criticisms which have been published against the Davis-Gibson copper cobalt liquid filter, and its use in the international light standard for sensitometry. One of the main criticisms is the fact that the required double salt of cobalt ammonium sulphate cannot easily be obtained in Europe. The author points out that the components in their correct proportions can be used without alteration of the properties of the filter. R. C. F.

3556. Method of Increasing the Printing Speed of Dichromated Gelatin. F. J. Tritton. *Phot. J.* 69. *pp.* 281–285, *June*, 1929.

The author discusses the use of various salts to increase the sensitivity and their effect on the period for which the film may be kept without further use and on the toughening of the tissue. The use of lanthanum and cerium for increased sensitivity is described, and their application to the carbon process, photogravure, carbro, photo engraving and photo lithography outlined. R. S. R.

3557. Wire Screen Filters for Photographic Photometry. G. R. Harrison. *J.O.S.A. and R.S.I.* 18. *pp.* 492–502, *June*, 1929.

Describes the preparation, calibration, use and advantages of wire screens to reduce the light intensity by a known amount. W. H. Ge.

3558. Thermophosphorescent Radiations of Hiddenite and Kunzite. O. Stuhlman, Jr. *J.O.S.A. and R.S.I.* 18. *pp.* 365–369, *May*, 1929.

Spectral analysis shows that the colour of hiddenite is due to iron and manganese. It exhibits thermophosphorescence at 1050° up to the ignition temperature. Two bands exist, one orange from 7000 Å. to 5890 Å. with maximum at 6470, and the other green with maximum at about 5400 Å. Kunzite showed by visual examination two bands with maxima at about 5200 Å. and 5930 Å. when heated above 210° C. J. E.

3559. Fluorescence Spectrum of Oxygen. F. Rasetti. *Nat. Acad. Sci. Proc.* 15. *pp.* 411–414, *May*, 1929.

The spectrum of light from a Hg arc scattered by oxygen at atmospheric pressure and photographed with a quartz spectrograph shows, besides the Raman lines already reputed by the author, a series of doublets extending from the ultra-violet limit of the plate down to the visible region. This appears as a fluorescence spectrum excited by the resonance line λ1849 of mercury. An account of the observed lines and suggestions for their interpretation are given. J. E.

3560. Raman Effect in Diatomic Gases. F. Rasetti. *Nat. Acad. Sci., Proc.* 15. *pp.* 234–237, *March, and pp.* 515–519, *June*, 1929.

The phenomena observed in the incoherent scattering of light by molecules can be easily accounted for by the quantum theory of dispersion. This has been shown by the author in Part I of the paper, and by other writers. In Part II of the present paper experiments are reported which show the relationship between Raman transitions and band spectrum structure much more clearly than before. The essential improvement in the apparatus consists in the use of the λ2536 mercury line as the exciting light. Working with a very narrow slit, perfectly sharp Raman lines are obtained, and their frequencies are measured within a few tenths of a frequency unit. In Part I only the general consequences of the application of the Kramers-Heisenberg formula to electronic and vibrational transitions were considered. In Part II rotational states and electronic fine structure of molecular levels are also taken into account, the gases dealt with being N_2, H_2, and O_2, from both the practical and theoretical standpoints. T. B.

3561. Photometric Study of the Raman Effect. P. Daure. *Comptes Rendus*, 188. *pp.* 1605–1606, *June* 17, 1929.

The ratio *r* between the intensity of positive Raman lines and the corresponding negative lines due to the same excitation was measured for the liquid chlorides $AsCl_3$, PCl_3 and CCl_4. Raman's equation for this ratio was verified within the limits of possible error. The variation of the intensity of a Raman line with given characteristic frequency, when the exciting frequency was changed, was investigated. The intensities of the Raman lines were proportional to those of the diffused lines; it follows that the intensities of the Raman lines in question are proportional to the fourth power of the exciting frequency. It was found that in certain cases the energy emitted by the Raman effect amounts to 1/10 of that emitted by molecular diffusion. The connection between the characteristic frequencies and the absorption frequencies deduced from the infra-red spectrum were investigated for cyclohexane. H. N. A.

3562. Raman Spectra of Sulphuric Acid and the Sulphates. S. K. Mukherjee and P. N. Sen Gupta. *Indian Journ. Phys.* 3. *pp.* 503–505, *June* 15, 1929.

Wood's experimental arrangement was used to obtain photographs in one hour with a constant deviation spectrograph. Lines corresponding to infra-red absorption at $10 \cdot 2\,\mu$ were found in the case of each sulphate and lines corresponding to absorption at $18\,\mu$, $9 \cdot 55\,\mu$ and $4 \cdot 68\,\mu$ in the case of acid. It is inferred that the SO_4-ion alone is operative in the case of a salt in solution. F. S.

3563. Wien's Displacement Law and Radiation Pressure from the Light Quantum Hypothesis. B. M. Srivastava and D. S. Kothari. *Indian Jour. Phys.* 3. *pp.* 493–497, *June* 15, 1929.

An enclosure with perfectly reflecting walls contains radiation, and the walls expand out normally, bringing about a change in the wave-length of the radiation due to the Doppler effect. The amount of this change is calculated on the quantum hypothesis, and from this the pressure exerted by the incident quanta on the moving mirror is obtained, and the change in energy for a quantum on reflection; thus $\Delta\nu$, the change in the frequency, can be calculated, the result being the same as with the wave theory. From this Wiens' displacement law can be deduced. The expression given by Larmor for the pressure exerted by radiation on a moving reflector is also considered and shown to follow from the quantum theory. H. N. A.

3564. Bands in Hydrogen Related to the Fulcher System. I. Sandeman. *Roy. Soc. Edinburgh, Proc.* 49. *pp.* 245–255, 1929.

The 3^3S–2^3S system of hydrogen lines of Richardson and Das [see Abstract 2185 (1929)] is extended, the band previously given as the null band (00) being taken as (20), while two additional vibrational levels are added on the infra-red side. An analysis of the system based on the new mechanics is given, and various tests are applied to prove the correctness of the new arrangement. A table containing the constants of the 2^3S and 3^3S states is appended. [See Abstract 2740 (1929).] T. H. P.

3565. Stark Effect of the Second Order for the Balmer Series of Hydrogen. H. R. v. Traubenberg and R. Gebauer. *Zeits. f. Physik*, 56. 3–4. *pp.* 254–258, 1929.

The divergence between the observed second order effect for the higher

Stark components and that computed from Schrödinger's theory, as found in the previous paper [see Abstract 2496 (1929)], is now shown to have been due to a false calculation of the theoretical value. When this is corrected, observed and theoretical red displacements agree for all the Stark components investigated. W. S. S.

3566. Stark Effect for Atoms Heavier than Hydrogen, and its Theoretical Quantum Interpretation. R. Ladenburg. *Phys. Zeits.* 30. *pp.* 369–383, *June* 15, 1929.

After a brief survey of the phenomena occurring with the Stark effect, the author shows, from a discussion of theory and experimental results, that nearly all the highly complicated appearances at present observed, due to electrical influences, for the series lines of higher elements can be satisfactorily explained by the quantum theory. The sections of the theory considered deal with the theoretical quantum interpretation of the longitudinal and transverse effects, the regularity of the transverse effect, the longitudinal effect and the effect of the higher orders, appearance of new "forbidden" lines and their theoretical interpretation, and the division into polarised components. The theory is particularly successful for the many series of helium. R. C. F.

3567. Band Spectra. R. Ruedy. *J. de Physique et le Radium,* 10. *pp.* 129–158, *April,* 1929.

Hund's theory of band spectra is presented with small modifications concerning rotatory doubling. This is a general property of molecular electronic levels $i_e > 0$ and is not a characteristic of symmetrical molecules only. The relations of the atomic spectra of Cu, Ag, Au, etc., to that of their compounds is discussed, and it is found that there is evidence of transitions between metastable states. The theory of the intensity of O_2 bands is in accordance with experience regarding the state of vibration. For transitions between rotation levels (P, Q and R branches) the selection rules are not so strict as for atoms. They depend upon the speed of rotation and electric moment of the molecule. F. S.

3568. Helium Band Spectrum. S. Imanishi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 189. *pp.* 237–252, *April* 29, 1929. *In English.*

In this continuation of previous work [see Abstract 2480 (1929)] an improved method of recording the iron arc has been used and photographic plates sensitised for the green and yellow with erythrosin and ammonia. Two new bands of par-helium $2S(n = 1) - 3P(n = 1)$ and $2S(n = 2) - 3P(n = 2)$ are analysed, and the $2S(n = 1) - 3P(n = 0)$ band mentioned by Weizel and Füchtbauer is completed. The $2s(n = 2) - 5p(n = 2)$ band of ortho-helium in the ultra-violet is also analysed, and the bands at λ4950 Å. and λ5350 Å. found by Merton and Pilley and by Fujioka have been reinvestigated. F. S.

3569. Band Spectrum of Helium. W. Weizel and E. Pestel. *Zeits. f. Physik,* 56. 3–4. *pp.* 197–214, 1929.

Twelve bands have been analysed, of which several were known already through the work of Weizel and Füchtbauer [see Abstract 3109 (1927)]. The discovery of several further vibration bands has improved the knowledge of vibration quanta and their dependence on the electron term. With increasing principal quantum number, all vibration quanta tend to the same limit, *viz.* the vibration quantum of He_2^+. The investigation of rotation structure shows that for the $p \equiv (1s\sigma)^2 . p\sigma p\pi\Pi$ terms the uncoupling in the triplet system is more marked than in the singlet system, while the reverse is true for the terms $\binom{x}{y} \equiv (1s\sigma)^2 . p\sigma d\pi\Pi$ and $z \equiv (1s\sigma)^2 . p\sigma d\sigma\Sigma$. F. S.

3570. Excitation of the Red and Blue Argon Spectra by Electronic Collisions. B. Schulze. *Zeits. f. Physik*, 56. 5–6. *pp.* 378–393, 1929.

The arc and first spark spectra of argon have been photographed in the visible part of the spectrum, using electrons with gradually increasing velocity to excite them. Seven steps were observed in the case of the arc spectrum, and in all cases agreement was found with the excitation voltages (velocities) calculated theoretically from the series terms. In this way a direct experimental confirmation of Meissner's analysis of the "red" spectrum was obtained. The excitation voltages of a number of lines of the first spark spectrum were obtained in the same way; they were compared with the critical potentials which have been observed previously, and with the excitation voltages observed spectroscopically. They agree well with those calculated from de Bruin's series terms. H. N. A.

3571. Isotope Effect in the Spectrum of Neon. H. Nagaoka and T. Mishima. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 200–202, *May*, 1929. *In English.*

The neon tube was immersed in liquid air to reduce the broadening of the spectral lines produced by the Doppler effect. The observations were made transversely to avoid self-reversal, a Hilger sliding interferometer being used; fringes were observed on analysing the lines with a constant deviation prism. Every strong line in the red and yellow portions of the spectrum was associated with a weak one, and this must be attributed to the isotope effect. A table shows the change of frequency between the two isotopes Ne(20) and Ne(22) for a number of lines. This is in all cases somewhat greater than that calculated for the change in the Rydberg constant; the excess is not as large as with other elements, and is most pronounced in $1s_2$, while $1s_3$, $1s_4$, $1s_5$ show deviations of similar order. It is thought that the results will be of theoretical value in drawing conclusions as to a difference of character of the nuclei of isotopes affecting the deviations of spectral terms. H. N. A.

3572. Series Spectrum of Selenium (SeIV). P. Pattabhiramayya and A. S. Rao. *Indian Journ. Phys.* 3. *pp.* 531–535, *June* 15, 1929.

Examines the spark spectrum of Se as measured by Messerschmitt, and Humphreys and Sawyer, and classifies those lines which belong to the SeIV spectrum. A list of the lines which enter into the classification, with the terms and term values obtained, is given. Other tables given deal with the variation of the logarithms of the difference in the values $^2P_1$ and $^2P_2$ with the logarithms of the nett nuclear charge, the comparative positions of some of the prominent members in the spectra of GaI, GeII, AsIII and SeIV, the progression of the terms in the spectra of these elements, and some unclassified pairs of frequency difference 4374 cm^{-1} with their probable classification. R. C. F.

3573. Ultra-Violet Bands of Sulphur. J. Gilles. *Comptes Rendus*, 188. *pp.* 1607–1608, *June* 17, 1929.

Several new bands have been discovered in the far ultra-violet in an uncondensed discharge in sulphur vapour at low pressure. The bands, which are degraded towards the red, seem to have P and R branches only. The frequencies of the band heads are tabulated. The fine structure has not yet been resolved. F. S.

3574. Carbon Spectrum. D. S. Jog. *Indian Journ. Phys.* 3. *pp.* 451–461, *June* 15, 1929.

After a brief survey of the work done on the C, C^+, C^{++}, and C^{+++} spectra of carbon, the author tabulates and examines the lines of the carbon spectrum, obtained from a heavy current carbon arc, between wave-lengths of 1930 and 2930 Rowland system. A classification of the CI spectrum is also given, which includes all the new lines obtained together with some of the old lines. R. C. F.

3575. Spectrum of Trebly Ionised Thallium. P. Pattabhiramayya. *Indian Journ. Phys.* 3. *pp.* 523–529, *June* 15, 1929.

Deals with the isoelectronic spectrum of TlIV, using the wave-length data given by Caroll, and employing Sommerfeld's regular doublet law of X-ray spectra, modified for optical spectra, for the extrapolation of the separations of the sub-levels. A comparison of the characteristic terms in the arc spectra of PtI, AuII, given by McLennan and McLay [see Abstract 1172 (1929)], and HgIII, given by McLennan, McLay and Crawford [see Abstract 1561 (1929)], is also given. Tables are included giving the scheme of multiplets formed by the combination of terms, the progression of the regular doublet law in the homologous spectra of PtI, AuII, HgIII and TlIV, the progression of the difference in sub-levels in the spectra of the homologous series of elements, and the progression of the $^{3\&1}P$, $^{3\&1}D$ multiplets in the sequence of the spectra. There is also a complete list of lines classified by the author. R. C. F.

3576. Arc Spectrum of Chlorine and its Structure. C. C. Kiess and T. L. de Bruin. *Bureau of Standards J. of Research*, 2. *pp.* 1117–1136, *June*, 1929.

In the arc spectrum of Cl, emitted by an uncondensed discharge in a Geissler tube containing the gas at low pressure, more than 200 wave-lengths were measured between the limits 4000 Å. in the violet and 9900 Å. in the infra-red. 62 % of these lines, together with those observed by Turner in the Schumann region, have been classified as resulting from combinations between terms of the doublet and quartet systems. These terms arise mainly from the basic term ^3P of the ion, the terms coming from ^1S and ^1D not being definitely established owing to the faintness of the lines. Nine sets of series-forming terms have been found. From these, the distance separating $^2P_2$, the base term of the neutral atom, from $^3P_2$, the lowest term of Cl^+, is found to be 104,991 cm.$^{-1}$, giving 12·96 volts as the ionisation potential of neutral chlorine. AUTHORS.

3577. Absorption of Ultra-Violet Light by Organic Substances. L. Marchlewski and J. Mayer. *Acad. Polonaise, Sci. et Lettres, Bull.* 3A. *pp.* 169–202, *March*, 1929. *In English.*

The authors describe the absorption spectra as ascertained by quantitative measurements of the extinction coefficients of some furan derivatives, namely, furfurol, furfuramide, furan-alcohol, and furan-carbonic acid, of the three methylbenzoic acids, nitrobenzoic acids, aminobenzoic acids, nitrotoluenes, benzoic aldehyde and α- and β-naphthoquinoline.

All these substances follow Beer's law, and all show more or less complicated selective absorption. Of special interest is the fact that all para derivatives absorb more strongly than the corresponding meta- and ortho-isomers, a regularity found already by Magini, who, however, used the qualitative method of Hartley, in the course of the study of some bisubstituted derivatives of benzene. This regularity is demonstrated clearly by the molecular extinction curves supplied in this paper.

AUTHORS.

3578. Molecular Absorption of Iodine in the Vacuum Ultra-Violet. H. Sponer and W. W. Watson. *Zeits. f. Physik*, **56.** 3–4. *pp.* 184–196, 1929.

Molecular iodine in the vapour state possesses three different regions of absorption in the ultra-violet. A series of narrow bands extends from 1950–1780 Å. At low pressures (corresponding with the vapour pressure at – 24° C.) a new series of bands is found in the neighbourhood of 1750 Å. These bands are not classified. Strong absorption is also observed over the region 1600–1500 Å. Two suggestions are made in an attempt to classify the long-wave system.

F. J. W.

3579. Sodium Chloride Phosphors containing an Added Cuprous Salt. Magdalene Forró. *Zeits. f. Physik*, **56.** 3–4. *pp.* 235–243, 1929.

A series of sodium chloride phosphors, containing 0·03–0·3 % of an added cuprous salt, all gave a well-defined absorption band at 255 mμ. The breadth of the band varied with different concentrations of cuprous salt. It is suggested that this variation in the breadth of the band is to be attributed to varying degrees of distortion of the crystal lattice (inner temperature). In support it is shown that as the temperature of the phosphor is raised from –193° to 500° C. the breadth of the band increases. An irreversible distortion of the lattice of phosphors containing 1 % added cuprous salt was obtained by heating at 600° C.

F. J. W.

3580. Wave-Lengths of the K-Lines of Copper using Ruled Gratings. J. A. Bearden. *Nat. Acad. Sci., Proc.* **18.** *pp.* 528–533, *June*, 1929.

Ruled gratings should give a standard of X-ray wave-lengths more reliable than those resulting from crystal measurements. The author has therefore constructed under Michelson's direction a glass grating of 600 lines per mm. and a glass and a speculum grating each with 50 lines per mm., and has chosen the K-lines of copper as being the longest intense X-ray lines which can be used without a vacuum spectrograph. His results for the α- and β-lines are $K_\alpha = 1\cdot5422 + 0\cdot0002$ Å.; $K_\beta = 1\cdot3926 + 0\cdot0002$ Å., whereas Siegbahn's values from crystal measurements are 1·5386 and 1·3893 respectively. Lack of homogeneity of the crystal is not admissible in explanation. Other suggestions are: (1) that the diffraction formulæ may not hold for these wave-lengths; (2) an index of refraction might have some effect in the wave-length as determined by the method.

T. B.

3581. Classical Scattering in X-Ray Reflection. P. Kirkpatrick. *J.O.S.A. and R.S.I.* **18.** *pp.* 452–458, *June*, 1929.

From preliminary experiments with radiation from a tungsten antikathode, a rock-salt crystal and aluminium scatterer, and ionisation chamber detector, results are obtained which support the Thompson polarisation factor and are in agreement with the conception of crystal reflection as a classical phenomenon, amenable to the principles of electromagnetic optics. W. H. Gᴇ.

3582. Scattering of X-Rays in Gases. G. Herzog. *Helv. Phys. Acta*, 2. 4. *pp.* 217–256, 1929. *In German.*

A continuation of previous work [see Abstract 3344 (1929)]. As was shown in the first paper, the scattering at any angle θ of a wave-length λ is represented by an expression involving $\sin \theta/\lambda$. The wave-length was previously kept constant and the observations were made at different values of θ, but the reverse is the case in the present experiments. The experimental arrangements are described fairly fully, and the theory of the measurements is also discussed at length. The scattering of X-rays in various gases, air, hydrogen, carbon monoxide, nitrogen, C_2H_2, C_2H_6, argon, N_2O and CO_2 at an angle of 90° to the primary beam has been observed, the radiations principally employed being the complete characteristic K-spectra of copper and silver targets. For a given scattering substance the scattering depends on the wave-length and, taking hydrogen as unity, the scattering coefficient increases for all the gases investigated with increase of wave-length. This can only be attributed to interference of the scattered beams. For gases having the same number of electrons per molecule the scattering coefficients under rigorously the same conditions are different, and the electronic scattering must, therefore, be different in the different cases, a result once more to be attributed to interference. The simple additive rule adduced by Crowther concerning the atoms in a molecule was not confirmed, and the conclusion is come to that interference must take place between the scattered rays from electrons of different atoms in the molecule. W. V. M.

3583. X-Ray Diffraction in Liquids and Solutions and the Molecular Structure Factor. P. Krishnamurti. *Indian Journ. Phys.* 3. *pp.* 507–522, *June* 15, 1929.

In continuation of previous work, the author has examined substances consisting of symmetrical molecules, both in the liquid state and in solutions of different concentrations. Tetranitromethane gives two rings in the liquid state, but in dilute solution in benzene or cyclohexane a strong scattering at small angles and a faint maximum at 3·02 Å.U. The strong inner ring in the liquid is due to diffraction by neighbouring molecules, while the outer ring is due to the structure factor of the molecule. Hexamethylene tetramine and carbon tetrachloride have also been examined. It is suggested that it is not the distance between neighbouring molecules, but the distance between the planes containing the maximum number of molecules per unit area which should be considered in the application of the Bragg formula to liquids. The use of hexamethylene tetramine powder for standardising an X-ray camera when using soft radiation is indicated. W. V. M.

3584. Double X-Ray Spectrometer. J. H. Williams and S. K. Allison. *J.O.S.A. and R.S.I.* 18. *pp.* 473–478, *June*, 1929.

Gives the details of the construction of a double spectrometer in which greater resolving power is obtained by reflecting the X-ray beam off two crystals in succession. The basis of the instrument is an optical spectrometer. W. H. Gᴇ.

3585. Nomograms for X-Ray Rotation Photographs. J. B. Friauf. *J.O.S.A. and R.S.I.* 18. *pp.* 479–487, *June*, 1929.

The nomograms are prepared for use when X-ray single crystal rotation or oscillation photographs are taken upon a plane plate fixed perpendicular to the X-ray beam at a distance from the crystal of between 4·8 and 5·2 cm. It is assumed that some important crystallographic axis is parallel to the axis of rotation, which is itself perpendicular to the X-ray pencil. Nomograms are then given for the equations $\alpha = V/\sqrt{R^2 + 25}$ and $R^2/D^2 = 1/(1 - 2\sin^2\theta)^2 - 1$, where R is the distance of a spot from the centre of the plate, V is one-half of the distance between two corresponding spots above and below the zero layer line, D is the distance from crystal to plate, and $\alpha = n\lambda/2d$. W. H. Ge.

RADIOACTIVITY.

3586. Fine Structure of the Magnetic Spectrum of α-Rays. S. Rosenblum. *Comptes Rendus*, 188. *pp.* 1549–1550, *June* 10, 1929.

The earlier investigation [see Abstract 3359 (1929)] has now been extended to the examination of the velocities of the α-particles emitted by RaA, RaC′, ThC′ and polonium. The α-ray of RaA has been obtained on the same photographic plate as the α-rays of ThC. The α-ray of RaA, together with a new ray (α_1—ray), was equidistant from the strongest ray of ThC. The separation corresponded with a difference in velocity of ± 0·003 of the latter. F. J. W.

3587. Detection of Atom Fragments. G. Hoffmann and H. Pose. *Zeits. f. Physik*, 56. 5–6. *pp.* 405–415, 1929.

A new method for the detection of atom fragments by means of the two-leaf electrometer in connection with a suitable ionisation chamber is described. This method consists in the measurement of the quantity of ions produced by a single H-ray. Measurements are given which were made with H-particles which were detached from aluminium by α-rays from polonium. These show the suitability of the method for the detection of atom fragments. J. J. S.

3588. Spectrography of the γ-Rays of the Radium Family by Means of Crystalline Diffraction. M. Frilley. *Ann. de Physique*, 11. *pp.* 483–567, *May–June*, 1929.

Contains a fully illustrated account of the method employed in the measurements previously recorded [see Abstract 3261 (1928)]. Emphasises the difficulty of determining the intensity of the different γ-rays concerned, either by the author's method or by those employed by other experimenters. Considers the origin of certain of the γ-rays in nuclear levels; the results so far obtained are not sufficient to resolve the numerous difficulties which exist in the theory of the nuclear structure and of radioactivity. The author is investigating an electrometric spectrographic method, which seems capable of getting over the difficulties due to the low intensities of the sources employed. H. N. A.

3589. Radioactive Methods in Physical Chemistry. I. Estermann. *Zeits. f. Elektrochem.* 35. *pp.* 368–373, *June*, 1929.

A summary of the results obtained by the application of radioactive indicators to physico-chemical problems. F. J. W.

HEAT.

3590. Thermal Conductivity in Non-Regularly Formed Refractories. U. Bordoni. *Accad. Lincei, Atti,* 9. *pp.* 692–695, *May* 5, 1929.

In modern apparatus forms are employed which are not geometrically regular. Methods are discussed for obtaining the thermal conductivity, approximately, or more exactly. A. D.

3591. Thermal Conductivity of Ice. S. Arzybyschew and I. Parfianowitsch. *Zeits. f. Physik,* 56. 7–8. *pp.* 441–445, 1929.

An improved apparatus is described in detail for the determination of thermal conductivities very similar to that employed in the classical method of Forbes, and a value is found for ice of $(55 \pm 0{\cdot}8)\ 10^{-4}$ cal./cm. sec. (Compare 0·0057 of Neumann and 0·0021 of Forbes.) H. H. Ho.

3592. Expansion Coefficient of the National Prototype Metre. E. König and F. Buchmüller. *Helv. Phys. Acta,* 2. 3. *pp.* 159–168, 1929. *In German.*

The authors explain in detail the procedure followed in the determination by a comparator method of the expansion coefficient of the standard metre. The result given for the range 2° to 37° is $(860_3 + 2{\cdot}3_3 t) \times 10^{-9}$, where t is ° C. This gives satisfactory agreement with the results of Perard and Maudet. R. S. R.

3593. Thermal Effects due to the Stretching of Brass Crystals. M. Masima and G. Sachs. *Zeits. f. Physik,* 56. 5–6. *pp.* 394–396, 1929.

The changes in temperature due to successive small amounts of stretching, carried out rapidly, were measured by means of a thermopile; and the deflections of the galvanometer, after about 8 seconds in each case, were plotted against the sectional area ratio f/f_0. The curves are compared with those showing the relation between the load and f/f_0. At first, when slipping is going on, the heat produced follows more or less the same course as the work expended; but it increases more rapidly than the load. This means that the energy which is stored up in the crystal (elastic energy), and which is not converted into heat, is more at first than in the later stages of the slipping process. At a certain point there is a sudden jump in the curve, the amount of heat produced becoming considerably greater. It seems that at this point and above it the inner energy which has been stored in the crystal is given out as heat. This seems to be connected with the commencement of slip on another slip surface. Other irregularities in the curve are found at still higher loads. H. N. A.

3594. Specific Heat of Metallurgically Important Substances over Large Temperature Intervals with Two New Types of Calorimeter. W. A. Roth and W. Bertram. *Zeits. f. Elektrochem.* 35. *pp.* 297–308, *June,* 1929.

The calorimeters employed were (1) the Puffer calorimeter, and (2) a wholly metal calorimeter, *i.e.*, a cylindrical block of aluminium with a hole containing a silver tube. The temperature was measured electrically. A sketch of the calorimeters with details is given. The paper gives measurements with tables of results and a comparison of the latter with those of other workers. Specific heats up to 900° C. of the following substances were measured: silica, lime, wollastonite, aluminium oxide, cryolite, sodium chloride, iron, magnetite, fazilite, and red hematite. The heats of transition from α- to β-quartz, from α- to β-cryolite, and from α- to β-iron were determined, also the heat of melting of salt and cryolite. From the series of values of the specific heat of wollastonite the change of its heat of formation with temperature was calculated. T. B.

3595. Determinations of the Specific Heat of Nitrogen and Carbon Dioxide at High Temperatures. M. Chopin. *Comptes Rendus,* 188. *pp.* 1660–1662, *June* 24, 1929.

The following values of the mean molecular specific heats at constant pressure of nitrogen and carbon dioxide at the respective temperatures (t° C.) stated have been deduced from experiments: Nitrogen, 200°, 6·95; 400°, 7·06; 600°, 7·17; 800°, 7·28; 1000°, 7·39. Carbon dioxide, 200°, 9·75; 400°, 10·40; 600°, 10·95; 800°, 11·38; 1000°, 11·75. For nitrogen the results can be expressed by the equation $C_p = 6\cdot82 + 0\cdot00058\,t$. For carbon dioxide the corresponding equation is $C_p = 8\cdot9 + 0\cdot61\,(t/100)^{0\cdot673}$. J. S. G. T.

3596. Heat Capacity of Hydrogen Iodide from 15° K. to its Boiling Point and its Heat of Vaporisation. Entropy from Spectroscopic Data. W. F. Giauque and R. Wiebe. *Am. Chem. Soc., J.* 51. *pp.* 1441–1449, *May,* 1929.

The authors have extended their work on hydrogen chloride and hydrogen bromide [see Abstract 1333 (1928)] to hydrogen iodide. As before, the present paper contains details of the calculation of the entropy calculated for the gaseous state with the assistance of spectroscopic data which are in agreement with those obtained from their calorimetric measurements and the third law of thermodynamics. Briefly stated, they have investigated the heat capacity of solid and liquid hydrogen iodide from 15·3° K. to its boiling point. The following data have been determined: Melting point, 222·31 ± 0·05° K.; boiling point, 237·75 ± 0·05° K.; heat of fusion, 686·3 ± 0·8 cal. per mole.; heat of vaporisation, 4724 ± 5·0 cal. per mole. Two high-heat capacity regions were found in the solid state, apparently transitions in the molecule, one of which, after progressing over a considerable temperature range, develops into the ordinary type. The entropy calculated from both experimental data and the third law of thermodynamics is compared with that calculated from spectroscopic data, leading to results in good agreement. S. G. B.

3597. Heat Capacities and Heat Functions of Metals. A. N. Guthrie and E. E. Libman. *Am. Chem. Soc., J.* 51. *pp.* 1711–1715, *June,* 1929.

The results of calculations made on the work of Wüst and Durrer show that the relative partial molal heat functions of the systems Pb-Sb and Bi-Cd are equal to zero for the eutectic temperatures, independent of the concentrations. The partial molal heat capacities of the components of the system Pb-Sb have been calculated at 700° C. and have been found to be constant and equal to the molal heat capacities of the pure liquid components. The same have been calculated for the system Bi-Cd at 300° and 1000° C. Assuming that the partial molal heat capacities are the same as the molal heat capacities of the pure liquid components at all temperatures, it is shown that the relative partial molal heat functions are zero not only at the eutectic temperature, but at all others. C. O. B.

3598. Binary System Carbamide-Ammonium Nitrate. Molecular Association in Each Compound. W. J. Howells. *Chem. Soc., J. pp.* 910–915, *May*, 1929.

As carbamide forms compounds with the nitrates of silver and mercury, a compound with ammonium nitrate was looked for, but not found within the temperature range investigated, up to 190°, when carbamide was introduced into fused ammonium nitrate. The equilibrium curve consists of two limbs with a eutectic point at 44·7° and 47 % of carbamide. Ammonium nitrate has a transition point at 126°. The molecular association was studied by observing the depression of the freezing point produced by adding dextrose, acetamide and ammonium nitrate to the carbamide, and also alkali nitrates and other salts to the ammonium nitrate mixtures; in the latter calcium nitrate is slightly dissociated, and ammonium chloride strongly associated. H. B.

3599. Effect of a Gas upon the Pressure of a Vapour. L. A. Sayce and H. V. A. Briscoe. *Chem. Soc., J. pp.* 1302–1307, *June*, 1929.

From Campbell's work [see Abstract 1283 (1915)] it follows that the concentration of a saturated vapour in a gas is not a true measure of the vapour pressure of the liquid, and that the very large number of "vapour pressure" measurements made by the gas-saturation method are subject to an error, unknown in extent, but in some cases of very considerable magnitude. Campbell advanced the theory that the low values he obtained were due to the adsorption of gas at the liquid-gas interface, and the present investigation attempts to apply a crucial test of the validity of his view, according to which, evidently, in the absence of liquid, a gas should have no effect on the pressure of a vapour. Independent measurements have been made both of the concentration and the pressure of a vapour in the presence and in the absence of a gas, the gas used being carbon dioxide and the vapour either ether or pentane. The results obtained appear definitely to contradict the view that the diminution of vapour pressure of a liquid in presence of a gas can be wholly attributed to the effects of solution or adsorption of gas in the liquid. H. H. Ho.

3600. Vapour Pressure of Isopropyl Acetate. C. J. Haggerty and J. F. Weiler. *Am. Chem. Soc., J.* 51. *pp.* 1623–1626, *June*, 1929.

Results are given of vapour pressure measurements of isopropyl acetate from 0° to 90°. Substitution of the proper constants in Kirchhoff's empirical equation, $\log_{10} P = A + B \log_{10} T + C/T$, gives for the vapour pressure curve the equation $\log_{10} P = 14{\cdot}2517 - 2{\cdot}0972 \log_{10} T - 2170{\cdot}1/T$. The values calculated from this equation agree fairly well with the observed values, the maximum percentage error, just over 1 %, occurring at 65·2°. Calculation of the boiling point from the equation gives the value 88·2°, and that of the molal heat of evaporation the value 7900 cal. Substitution of this value in the Trouton equation gives 21·8 cal. per degree for the molal entropy of vaporisation, isopropyl acetate being thus a normal liquid. Further, the molal entropy of vaporisation at 35°, at which temperature the concentration of the vapour is 0·00507 mol. per litre, is 27·6 cal. per degree, which agrees well with the mean value, 27·4, obtained by Hildebrand for normal liquids. T. H. P.

3601. Vapour Pressure of Ethylene Chloride between − 30° and 100° C. J. N. Pearce and P. E. Peters. *J. Phys. Chem.* 33. *pp.* 873–878, *June*, 1929.

The vapour pressure of ethylene chloride has been determined for temperatures − 30° to 100° C., the apparatus used being similar in principle to that first used by Johnston, and modified by Smith and Menzies [see Abstract 370 (1911)]. Between 243° K. and 363° K. the vapour pressure is given by the equation $\log p = - 4481\cdot12/T - 52\cdot3092 \log T + 0\cdot07153T - 0\cdot000041847T^2 + 128\cdot756$. Interpolation of the large scale plot of the pressure-temperature curve shows the normal boiling point of ethylene chloride to be 84·1° C. The molal entropy of vaporisation, $\Delta H/T_b$, at the boiling point is calculated to be 21·68 calories, and the molal heat of vaporisation 7745 calories. T. B.

3602. Determination of the Gasoline Content of Natural Gas and Analytical Separation of Natural Gases by Isothermal Fractional Distillation. M. Shepherd. *Bureau of Standards, J. of Research,* 2. *pp.* 1145–1199, *June*, 1929.

This paper describes a method for the accurate determination of gasoline in natural gas. The determination involves a special separation of the natural gas by fractional distillation at low temperatures and pressures. A recombination of the resultant fractions is made in such a way that it is possible to determine the maximum amount of hydrocarbon condensate present in the original gas which possesses any given vapour pressure at any given temperature. Special forms of apparatus are used for separating the higher boiling constituents and determining their liquid volume to 0·001 ml. Apparatus and procedures are described in detail, analytical results are given, and a direct comparison is made with existing field and laboratory methods. The analytical separation of natural gases and their commercial condensates is also discussed. The paper as a whole is intended to be a simple instruction-book for those who wish to engage in such work. AUTHOR.

3603. Upper Limit of Energy Density and the Degradation of Gas at High Temperatures. S. Suzuki. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 64–67, *Feb.*, 1929.

The author points out the difficulty of postulation of the limit of high energy density. According to the theory of relativity, anything material acquires an infinitely large amount of energy on attaining the velocity of light. Davisson's experiment based on de Broglie's idea points out that a material corpuscle behaves similarly to light when its velocity approaches the light velocity. The author puts forward the hypothesis that matter is transformed into light quantum when it attains the light velocity, the energy of transmutation being regarded as finite. In consequence, Lorentz' transformation should be modified at high velocity and not the notion of the existence of the upper limit of density of energy. As an outcome of this argument the author develops a new radiation formula and the shortest limit of the wave-length of the line spectra. It is noted that the assemblage of corpuscles tends to have the same velocity at an extremely high temperature, thus, the velocity distribution of Maxwell changes into that of Clausius. Such a state is called gas degradation at high temperatures, and the paper attempts to derive the equation of the gaseous state with the above assumptions. S. G. B.

3604. Statistics of Bose–Einstein and Fermi–Dirac and the Upper Limit of Energy Density. S. Suzuki. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 68–71, *Feb.*, 1929.

An extension of the previous treatment [see preceding Abstract] to give the exact solution after Einstein and Fermi, in order to bridge over the two extremes, *i.e.*, the lowest and highest temperature. Sommerfeld's method is employed for this purpose. The results as obtained on the Bose–Einstein and Fermi–Dirac hypotheses are derived and compared.

S. G. B.

3605. Investigations in the Critical Region. Part III. Energy Measurements with the Help of the Joule Effect. K. Bennewitz and N. Andreewa. *Zeits. f. phys. Chem.* 142. *Abt. A.* 1. *pp.* 37–66, *June*, 1929. *In German.*

The paper is divided into an experimental and a theoretical section. In the former two suitable calorimeters are fully described and figured. One is suitable for low and the other for high temperatures. Curves are plotted from the observations, the ordinates being the reduced Joule effect, *i.e.*, $(Q/m - RT_K/M)/(3RT_K/2M)$ and the abscissæ the reduced density of the gas, *i.e.*, δ/δ_K. The gases A, O_2, N_2, and CH_4 give the same curves. The curve for CO_2 lies above that for the other gases. The theoretical part of the paper is taken up with a discussion of the experimental results at the critical point from an energy standpoint. The authors consider the criterion of the critical point to be the beginning of complete dissipation. The statement is made that a four-body system possesses "amassing centres" (Haufungstellen) in the Boltzmannian sense, *i.e.*, places with an energy defect which are balanced by places with excess energy. Volmer and Farkas (*Zeits. f. phys. Chem.* 125. p. 236, 1927) have investigated the size of the particles resulting from the dissipation of the amassing centres. If we consider a substance at the ordinary critical point and heat it at constant density to a high temperature, it is converted to a gas at maximum entropy, the potential energy increases from $-9RT_K/4$ to $-3RT_K/2$. This increase in energy is called the "Haufungswärme," and is in agreement with the experimental results. The curve for CO_2 shows the presence of association which is calculated to be 7 %; the energy of association is -8765 cal. per mole $(CO_2)_2$. It is not possible from the form of the AU, δ curve to separate the "Schwarmbildung" (aggregation) from the true association. [For Parts I and II see Abstracts 718 and 1790 (1927).]

T. B.

3606. Blackness of Black Bodies and Illumination of Light Wells. H. Buckley. *J.O.S.A. and R.S.I.* 18. *pp.* 216–222, *March*, 1929.

In work by the author on the distribution of radiance on the inside walls of a number of uniformly heated enclosures, it was shown that for purely diffuse emission and reflection of radiation the radiance at any point on the walls is given by an integral equation of the second kind. This equation expresses the fact that the radiance at any point on the inside of the enclosure is equal to the initial radiance due to the thermal emissivity at the point, increased by the reflected portion of the radiation received from the rest of the enclosure. The effect of an aperture in the walls of a constant temperature enclosure of arbitrary shape is to produce a defect from black body radiance at a point which is equal to the radiance at the same point of the enclosure when not self-radiating but illuminated by a uniformly diffusely radiating sky of unit radiance. The determination of the defect from black body radiance is thus possible, in any specified enclosure by means of a brightness measurements with an illumination photometer on a scale model of the enclosure when illuminated by a uniform diffusely radiating artificial sky. Such measurements are actually made in two cases which submit to mathematical treatment, namely, (1) a light well of square section 6 in. × 6 in. × 60 in. (deep) and (2) a light well of rectangular section 6 in. × 60 in. × 60 in. (deep). The brightness tests were made by means of a Macbeth illuminator. The results are fully described and illustrated by curves. S. G. B.

3607. Optics of Stratified Semi-Conductors. G. Jaffé and J. Daillidé. *Ann. d. Physik*, 2. 1. *pp.* 1–26, *June* 7, 1929.

The paper deals with the conditions under which, according to Maxwell's theory, a body is black, *i.e.*, no light is reflected from its surface and all is absorbed. The conditions can hold only for scattering in non-homogeneous stratified bodies and in the simplest case for parallel stratification. The authors show mathematically that laws can be established for such bodies, and these are applied in two special cases. R. S. R.

3608. Theoretical Basis of Kinetic Gas Theory. V. Glumac. *Zeits. f. Physik*, 56. 5–6. *pp.* 432–434, 1929.

The kinetic gas theory equation $pV = \frac{2n}{3}\left(\frac{mv^2}{2}\right)$, where v is the number of molecules in the volume V, is deduced from the Bernoulli equation for stationary flow in a fluid, $\frac{p}{\rho} + \frac{v^2}{2} =$ constant (no external forces). W. S. S.

3609. Effect of the Addition of Hydrogen and Water on the Radiation Emitted from the Carbon Monoxide Flame. W. E. Garner and F. Roffey. *Chem. Soc., J. pp.* 1123–1140, *June*, 1929.

The addition of hydrogen or water to the flame of carbon monoxide causes a diminution in the intensity of emission of radiation. These changes in the character and intensity of the radiation are of importance for the study of the catalytic effect on the speed of flame. The investigations described were undertaken to determine the extent to which both the chemical and physical types of catalytic effect are present in flames. On addition of H_2 or H_2O the radiation from the flame decreases as the speed of flame increases, the effects of the two gases being very nearly the same. At 0·02–0·04 % of H_2 there is a critical region, where the radiation from the flame falls abruptly and the properties of the flame undergo a marked change. Logarithmic relations are found to hold between the speed of flame and the radiation emitted. They afford support for the "energothermic" theory of the catalysis. T. B.

3610. Use of Paraffin between 20 μ and 40 μ. L. Kellner. *Zeits. f. Physik*, 56. 3–4. *pp.* 215–234, 1929.

Paraffin is shown to possess a very high transmission factor for infrared radiations between 20 μ and 40 μ, and is, therefore, exceedingly useful for use as windows for microradiometers in this region. It is also gastight and, owing to its high selective absorption below 16 μ, filters out from the radiation all wave-lengths below this value. Results are also given for certain physical properties of rock-salt and fluorspar in this region, the transmission of very thin rock-salt being measured. From this transmission curve values for the extinction coefficient between 20 μ and 37 μ are calculated. From the experimentally determined curve of the reflection power of fluorspar in the region of the infra-red, it is shown that there is only one maximum value, at 32·8 μ, and not two, as stated by previous authors. In the region 26 μ to 30 μ the reflection power increases at a constant rate, without any indication of a maximum value. R. C. F.

3611. Entropy, Probability, Symmetry. A. Sellerio. *N. Cimento,* **6.** *pp.* 236–242, *May,* 1929.

Blending the Second Law of Thermodynamics with Curie's principle that the effects cannot be less symmetrical than the causes, the author reaches a criterion for numerically evaluating the symmetry of a system consisting of a crowd of individuals. In this way the concept of symmetry becomes quantitatively related to the entropy and the probability. A. D.

3612. Maxwell-Clausius Relation and Carnot's Principle. J. E. Verschaffelt. *Comptes Rendus,* 188. *pp.* 1384–1386, *May* 27, 1929.

Criticises the demonstration of Karpen [see Abstract 2537 (1929)], which, it is contended, is based upon a special case which is not in general true. F. S.

3613. Thermodynamic Notations. G. Bruhat. *Comptes Rendus,* 188. *pp.* 1600–1602, *June* 17, 1929.

The author proposes a simple notation for partial differentials, in which the constant " variable " is indicated as a subscript thus: dx_z, dy_z, dy_z/dx, dy/dx_z, δu_x, δx_u, etc. Differentials which are limiting values are discriminated from differentials which are not limiting values. Four simple algebraic identities are established between four variables, employing the notation explained, and these lead immediately to the deduction of a number of thermodynamic relations, including Clément and Desormes's identity, Reech's identity and four classical thermodynamic relations. J. S. G. T.

3614. General Thermodynamic Integration Factor of the Entropy Function. A. Press. *Zeits. f. Physik,* 56. 1–2. *pp.* 131–146, 1929.

The first part of the paper shows that in the ordinary range of saturated mixtures the pv relationship does not need a thermodynamic integration factor. The heat equation thus becomes merely $Q = U + pv$. Outside this range two methods of integration are available. The first involves the assumption of a relationship between p and v expressed as $p = f(v)$, defined by the thermodynamically established variables. Thus the thermodynamic equation becomes $Q = U + \int f_2(v)dv$. The second method allows for direct integration by multiplication by an integrating function μ, which in the general mathematical case is dependent on two variables. This leads to a form of the equation $\int \mu . dQ = \int \mu(dU + pdv)$. The paper discusses the various cases in detail and, finally, two equations for pv are deduced, one for low temperatures and normal volumes, and the other for high temperatures and large volumes. S. G. B.

SOUND.

3615. The New Acoustics. W. H. Eccles. *Phys. Soc., Proc.* 41. *pp.* 231–239, *June* 15, 1929.

A review is given of recent developments in theoretical and practical acoustics. The introduction of new experimental methods and apparatus, chiefly electrical, has enabled great progress to be made in the study of acoustic pressure variations. Among the more important pieces of apparatus which have contributed to this advance may be mentioned the condenser microphone, the triode amplifier, the triode generator of oscillations and electrical filter circuits. On the theoretical side further advances have been made by utilising the analogies between sound vibrations and electrical vibrations and attacking acoustic problems indirectly. Examples of the outstanding advances resulting from the new methods are to be found in the accuracy of measurement of architectural acoustics and the growth of psychological acoustics. Among the many other practical applications of the new ideas are mentioned the distortionless amplification of speech and music for broadcasting and the amplification of different frequency bands by different degrees to give no apparent distortion. An example of the progress resulting from the utilisation of electrical analogies is to be found in the improvements in the rendering of speech and music by the gramophone. These have largely resulted from comparison of the moving parts of the gramophone with the constituents of an electrical artificial line. The paper concludes with the suggestion that systematic study of these new developments should be undertaken in schools and colleges. A. W.

3616. Quartz Tuning Fork in High Vacuum. Holweck and Lejay. *Comptes Rendus,* 188. *pp.* 1541–1543, *June* 10, 1929.

Describes preliminary experiments on a quartz oscillating system built up from two quartz fibres 0·2 mm. diameter and 15 cm. long joined to form an acute **V**, the apex of which carries a little quartz sphere whilst the two ends are joined to a quartz fork, to form an apparatus similar to that of Wertenstein [see Abstract **2747** (1928)]. It is claimed to be a convenient portable standard for the measurement of small intervals of time. Together with a photoelectric cell it can be used in electrical measurements.

W. H. Ge.

3617. Acoustics of Large Rooms. M. J. O. Strutt. *Phil. Mag.* 8. *pp.* 236–250, *Aug.,* 1929.

Deals theoretically with Sabine's experimental result, that the duration of residual sound in a large room depends only on the volume and the absorbing power. Previous theories start from considerations of reflection at the walls, but phase relations are left out; a homogeneous distribution of energy over the space when the source stops is often assumed, which experiment shows is not necessary for the correctness of Sabine's law. Discusses the problem of forced oscillations in a continuous medium with arbitrarily distributed absorption, and shows that Sabine's law is a general asymptotic property of such oscillations if the quotient of the forced frequency over the lowest free frequency of the system tends to infinity. Special experimental features are discussed from this point of view. Sabine's law should hold in other departments of physics, for example, with electromagnetic radiation in closed spaces. H. N. A.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

3618. Proof and Extension of Heaviside's Operational Calculus for Invariable Systems. B. van der Pol. *Phil. Mag.* 7. *pp.* 1153–1162, *June*, 1929.

The general problem of the behaviour of an invariable system, starting from any given initial conditions and acted upon by a force given as a function of the time, is found to be solvable by the extension, worked out by the author, of Heaviside's operational calculus. J. J. S.

3619. Theory of Light. F. J. v. Wiśniewski. *Zeits. f. Physik*, 55. 3–4. *pp.* 221–230, 1929.

Proposes a generalisation of Maxwell's equations and shows that the generalised equations correctly represent the behaviour of light in material media. E. E. F. d'A.

3620. Introduction of an Electric Charge Vector. Application to the Synthesis of the Theories of Electromagnetism, Light and Gravitation. E. Sevin. *Comptes Rendus*, 188. *pp.* 1603–1604, *June* 17, 1929.

A force p of invariable magnitude is introduced in considering the relation between an electron and the ether; this is in the axial direction with respect to the universe when the electron is at rest. The vector p undergoes a rotation η in the direction of the velocity when the electron has an absolute velocity v with respect to the ether, and since the direction of the charge vector e is the same as that of p, it is also rotated; e can then be decomposed into an axial vector $e \cos \eta = e\sqrt{1 - v^2/c^2}$ and a second vector $e \sin \eta = ev/c$, which has the same direction as v; the latter is concerned in the production of the magnetic vector. The relativity relations are considered; the relations with the law of Biot and Savant and the theories of light and gravitation fit in with the new theory. H. N. A.

3621. Electromagnetic Theory Based upon a Discrete Ether. A. Véronnet. *Comptes Rendus*, 188. *pp.* 1488–1490, *June* 3, 1929.

A continuation of the attempt to formulate electromagnetic theory in terms of an ether composed of sub-electronic particles [see Abstract 3276 (1929)]. Deduces the two laws of Maxwell and the Stark and Zeeman effects. The five parameters of the medium are thus determined. A charge moving along a conductor produces vortices centred upon it, and the sum of these vortices is proportional to the charge passing through the section of the conductor. In order to produce an e.m.f. the magnetic field must vary. In the steady state the vortices are rapidly dephased and their action becomes zero. E. E. F. d'A.

3622. Effect of Gases on the Electric Charges Developed by Heated Metals. D. H. Bangham and D. R. Lewis. *Chem. Soc., J.* *pp.* 1140–1150, *June*, 1929.

It was shown by Hartley [see Abstract 1318 (1914)] that a metal surface, when heated in contact with different gases, tends to become charged to a different potential characteristic of each gas. The authors have failed to reproduce this effect quantitatively, but at the temperature used oxygen was found to give rise to a positive displacement of the "equilibrium potential" and hydrogen to a negative. The charging up of the metal is of the nature of a Volta effect, being dependent for its manifestation on the dynamical exchange of ions between the two surfaces. The ions were probably those of potassium and sodium. The power of the metal to emit these ions is diminished by the presence of occluded oxygen or nitrogen. T. B.

3623. Direct-Current Electrostatic Machine. H. Chaumat. *Comptes Rendus*, 188. *pp*. 1490–1492, *June* 3, 1929.

Outlines the arrangement of a generator on principles already discussed [see Abstract 2550 (1929)]. It consists of two discs mounted side by side, each provided with six armatures. The one set of armatures makes alternate contact with two brushes, one of which is joined to all the armatures of the other disc. When the former disc turns the fixed and moveable armatures form a variable capacity. An initial source of current is fed to the first brush. The power of the motor is equal to $\frac{1}{2}np^2cmu^2$, where p is the number of armatures, n the number of turns per second, c/m the capacity of a condenser, and u is proportional to the initial charge. The power may be up to 2 kw., with a current of 0·2 ampere at a maximum e.m.f. of 20,000 volts. E. E. F. d'A.

3624. Atmospheric Electricity. E. Mathias and C. Jacquet. *Comptes Rendus*, 189. *pp*. 14–15, July 1, 1929.

A description of the variations of the terrestrial electric field at the station at the summit of the Puy de Dôme. A radium collector 5 cm. in diameter is fixed in the centre of a steel thread 20 m. long, held parallel to the ground at a distance of 1·91 m. between two isolated systems carried by posts installed in the interior of two huts. The greatest precautions are taken in the matter of isolation on account of the frequency of storms around the station. The results concern the period of the summer of 1928, during which measurements were taken without interruption. Tables give the mean values and diurnal variations. The field is weaker at night than during the day, and varies from about 130 volts to 183·8 volts. Comparisons made with observations taken at the station in the plain give hopes of obtaining interesting results in the near future. T. C. H.

3625. Thunderstorms and Electric Lines. C. Dauzère. *Soc. Franç. Elect., Bull.* 9. *pp*. 575–598, *June*, 1929.

The author describes tests carried out at places where damage from lightning discharge was most frequent and severe. It was shown that in these regions the geological character of the soil varied from its surroundings, it was a better conductor, and it gave increased ionisation to the air. Where electric power lines, of high or low tension, run in these regions or especially near their boundaries, or if transformers or power stations are placed there, the chances of damage in these circuits are greatly increased. The author suggests a geological survey where the lines, etc., exist to instal extra precautions in the more dangerous parts and a preliminary survey to avoid these parts before new lines are installed. [See Abstracts 2790 and 2791 (1928).] R. S. R.

DISCHARGE AND OSCILLATIONS.

3626. Charge of Centres of Emission. A. Occhialini. *Accad. Lincei, Atti*, 9. *pp.* 655–657, *April* 21, 1929.

Projects upon the slit of a spectroscope the image of a horizontal spark between a negative electrode of magnesium and a positive electrode of copper and removes the magnesium electrode from the slit just enough to make the line of the spark at λ4481 invisible in the spectroscope. Then the electrodes are reversed, and the author observes that the line visibly returns and disappears after a further notable displacement of the electrode from the slit. For every element the ratios of the wave-lengths of lines with positive and negative electrodes are the same for lines emitted by centres of the same charge, but they grow with the order of ionisation. The measurement of the wave-lengths of lines with different polarities of the electrodes, therefore, gives information regarding the electrical state of the emitting centres. E. E. F. d'A.

3627. Form and Structure of Sparks. Part VI. Long Sparks in Organic Vapours. T. Terada, U. Nakaya and R. Yamamoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 192. *pp.* 271–290, *June* 24, 1929. *In English.*

Examines the form of sparks in organic vapours with a view to correlating the effects of mixing certain organic compounds with air and explosive gases on the form of long sparks obtained, thereby extending results previously given for long sparks in different gases [see Abstract 2553 (1929)]. The vapours used, which were mixed with air in various proportions, were: CH_3I, C_2H_5I, C_2H_5Br, $CHCl_3$, CCl_4, C_2H_5OH, CH_3OH, $C_2H_5OC_2H_5$, CH_3COCH_3, $CH_3CCl_2CH_3$, $CHCl_2CHCl_2$, C_6H_6, $C_6H_5CCl_3$, C_6H_5COCl, Br and C_3H_7Br. For the halogen compound vapours, when mixed with air, the spark is generally of the smooth three-part type, provided the percentage of vapour in the air exceeds a critical value. This critical value is dependent on the ratio of the weight of halogen atoms to the total molecular weight, and, mass for mass, chlorine is the most effective, iodine next, whilst bromine is definitely inferior. Only the folded structure near the positive electrode of the normal zigzag spark is enhanced by vapours of the alcohols, ether or acetone. With benzene vapour the spark is changed to a form which is similar to the small capacity spark in air, and can be compared with a modification of the three-part spark without the negative part. Previous work has shown that the formation of the smooth positive or negative part of a long spark is aided by the formation of a pilot brush. The development of this pre-discharge is apparently aided by the addition of halogen compounds, being probably due to enhanced ionisation near the electrodes. Alcohols and ether, on the other hand, appear to be effective in preventing such a pre-discharge. The differences between bromine and the other halogens, however, suggests that the formation of the pilot brush may be connected with a possible generation of soft X-rays at the electrodes. The paper is well illustrated with photographs. R. C. F.

3628. Electric Discharge between Two Spheres. R. Darbord. *Comptes Rendus*, 188. *pp.* 1665–1667, *June* 24, 1929.

In the case of a rare gas, where the electrons collide in an elastic manner, Franck and Hertz have shown that the conditions of the electric discharge are determined by the difference of potential between the electrodes. In oxygen, on the other hand, where electron collisions are soft, the discharges may be governed by the strength of the electric field at the point where it is most intense. The experiments of Abraham and Villard [see Abstract 123B (1912)] on the electrostatic discharge between two spheres in air at atmospheric pressure have been carefully examined, and it is found that for two given spheres the discharge is produced at a determined value of the maximum electric field. For wide values of the radius (D) and distance apart of the spheres, the maximum filed (*h*) required for the explosive potential varies slowly. For example, if D = 5, 10, 30 (cm.), then *h* = 38, 35, 31 (kilovolts per cm.) respectively. Formulæ connecting the various quantities are given in the paper. T. B.

3629. Space Charges. I. Langmuir. *Phys. Rev.* 33. *pp.* 954–989, *June*, 1929.

Discusses the effect of positive ions generated at a plane anode upon the space-charge limitation of electron currents from a parallel kathode. Mathematical analysis shows that single ions emitted with negligible velocity permit $0 \cdot 378(m_p/m_e)^{\frac{1}{2}}$ additional electrons to pass; but with an unlimited supply of ions, the electron current approaches a limiting value $1 \cdot 860$ times that which flows when no ions are present, and the electron current is then $(m_p/m_e)^{\frac{1}{2}}$ times the ion current, both currents thus being limited by the space charge and the electric field being symmetrically distributed between the electrodes. Single ions introduced into a pure electron discharge at a point 4/9ths of the distance from kathode to anode produce a maximum effect, $0 \cdot 582(m_p/m_e)^{\frac{1}{2}}$, in increasing the electron current. These conditions apply to a kathode emitting a surplus of electrons surrounded by ionised gas. The kathode sheath is then a double layer with an inner negative space charge and an equal outer positive charge, the field being zero at the kathode and at the sheath edge. The electron current is thus limited to $(m_p/m_e)^{\frac{1}{2}}$ times the rate at which ions reach the sheath edge. If ions are generated without initial velocities uniformly throughout the space between two plane electrodes, a parabolic potential distribution results. If the total ion generation exceeds $2 \cdot 86$ times the ion current that could flow from the more positive to the more negative electrode, a potential maximum develops in the space. Electrons produced by ionisation are trapped within this region and their accumulation modifies the potential distribution, yielding a region (named plasma) in which only weak fields exist and where the space charge is nearly zero. E. E. F. d'A.

3630. New Type of Cadmium Vapour Lamp. H. Nagaoka and Y. Sugiura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 191. *pp.* 263–270, *June* 3, 1929. *In French.*

In the lamp here described the cadmium is contained in a central tube of fused quartz surrounded by a heating coil of tungsten or molybdenum. This tube has a small opening at the top, above which is situated the anode. The anode has a central hole to allow passage of the cadmium vapour into a small cylinder, also of fused quartz, open at both ends and provided with a hole in the middle to allow light to pass out to a window at the end of a branch tube in the containing vessel. The kathode is of the Coolidge type and is situated a little distance away from the upper end of the small quartz cylinder. The containing vessel is water cooled and is evacuated by a condensation pump. Only 100 volts are applied between the anode and kathode, and a current of $0 \cdot 3$ or $0 \cdot 4$ ampere through the tube suffices to give an intense and stable light when the cadmium is heated to about 300° C. The lamp is very convenient and easy to operate, and will function continuously for about 3 hours. The red spectrum line given by it is extremely fine, and with this line sharp fringes were obtained up to the limiting distance (200 mm.) on a Hilger Fabry-Perot interferometer. When using this instrument it was noticed that as the distance between the two silvered surfaces was varied a periodic variation of the sharpness of the fringes was obtained. It thus appears probable that the red cadmium line is not a single line, but that it has a complex structure. This question will be investigated with other apparatus. A. W.

3631. Paths of Charged Particles in Electric and Magnetic Fields. W. Bartky and A. J. Dempster. *Phys. Rev.* 33. *pp.* 1019-1022, *June*, 1929.

A combination of electric and magnetic fields is described which is suitable for positive-ray analysis experiments, or precise determinations of the ratio of charge to mass. The orbits of charged particles in the radial electric field and transverse magnetic field of the system are computed, and it is shown that a beam of rays of various velocities diverging from a point are brought to a focus provided the variations are not too large. Formulæ are given for computing the errors introduced by variations in direction and velocity. AUTHORS.

3632. Longitudinal Magnetic Effect on Bundles of Slow Electrons. J. Thibaud. *J. de Physique et le Radium*, 10. *pp.* 161-176, *April*, 1929.

A description is given of the phenomena observed when a narrow bundle of slow electrons traverses axially a magnetic field on a part of its course. An account of the phenomena has been previously given [see Abstracts 1643 and 1644 (1929)] and in the present paper they are further discussed and tables of results and diagrams are included. J. J. S.

3633. Diffraction of Electrons. P. Tartakowsky. *Zeits. f. Physik*, 56. 5-6. *pp.* 416-420, 1929.

A description is given of an investigation by an electrical method of diffraction with electrons, up to a velocity of about 1500 volts, in a thin sheet of Al foil. Diffraction rings were observed. J. J. S.

3634. Ionisation by Electron Impact. K. Ochiai. *Phys. Math. Soc. Japan, Proc.* 2. *pp.* 43-52, *April*, 1929. *In English.*

Hippel recently calculated that the ionisation probability attains its maximum value at twice the ionisation potential, and experimental results for mercury vapour showed maximum ionisation at about twice the ionisation potential. Hippel's calculations were based on J. J. Thomson's formula for scattering. In the present paper the problem is treated from the standpoint of wave mechanics, and applications of the formulæ obtained to atomic hydrogen shows that maximum ionisation should be obtained for a potential slightly less than twice the ionisation potential. A. W.

3635. Note on "Oscillations in Ionised Gases." L. Tonks and I. Langmuir. *Phys. Rev.* 33. *p.* 990, *June*, 1929.

For the original paper see Abstract 1637 (1929).

3636. Some Problems Relating to the Mobility of Gaseous Ions. A. M. Tyndall and C. F. Powell. *Phys. Soc., Proc.* 41. *pp.* 249–255; *Disc.*, 255–257, *June* 15, 1929.

After enumerating a few results which are well established, the difference between positive and negative mobilities is briefly discussed with reference to Langevin's theory and to a "dynamic" cluster theory. The effect of vapours with a marked dipole in lowering the mobility of the negative ion is shown to follow from theory. The results obtained by various workers in pure gases are outlined and then the properties of positive ions of short age are dealt with. The paper concludes with suggestions for future work and a description [by C. F. Powell] of apparatus using the "four-gauze" method for investigations of both positive and negative ions in pure monatomic and diatomic gases. A. W.

3637. Photo-Conductivity of Rock-Salt Crystals under Pressure. M. Podaschewsky. *Zeits. f. Physik*, 56. 5–6. *pp.* 362–369, 1929.

Rock-salt crystals are coloured by means of X-rays and then subjected to pressure. The photo-current decreases quickly at first, and then tends asymptotically towards a constant value. On increasing the pressure it tends towards a still smaller value. Sensitivity can be restored by further X-radiation. E. E. F. d'A.

3638. Theory of the Photoelectric Effect. P. Auger. *Comptes Rendus*, 188. *pp.* 1287–1289, *May* 15, 1929.

Summarises the theories of photoelectric action and points out that Sommerfeld's theory, though correct as a first approximation, does not cover the high frequencies of γ-rays. Electrons originating in the L-level introduce new terms representing the dispersion relative to the $\sin^2$ law. E. E. F. d'A.

3639. Photoelectric Current in Air at Ordinary Pressures. A. Blanc. *J. de Physique et le Radium*, 10. *pp.* 187–197, *May*, 1929.

The curve representing the photoelectric current as a function of the field in air at ordinary pressure shows no saturation. This fact is unexplained. Now experience shows that for the same metal under identical conditions, but exposed to different illuminations, curves are obtained which belong to the same family and have ordinates proportional to the illumination, while for two different metals the curves belong to different families and can intersect without merging. A change in the composition of the incident light changes the shape of the curves belonging to the same metal. The change varies with the fatigue of the metallic surface. The author supposes that the number of ions produced in the air by each electron increases with the field in a manner varying from one metal to another. Hence no saturation is possible. E. E. F. d'A.

3640. Photoelectric and Thermionic Properties of Molybdenum. M. J. Martin. *Phys. Rev.* 33. *pp.* 991–997, *June*, 1929.

Ribbons of molybdenum were heated to 1325° C., in a high vacuum, and photoelectric currents due to a quartz mercury arc were measured by a quadrant electrometer. The sensitivity increased during heating and reached a steady value, and simultaneously the wave-length limit shifted from 2600 Å.U. to about 3800 Å.U. The photoelectric work function was found to be $3 \cdot 22 \pm 0 \cdot 16$ volts. The thermionic work function of the same strip was found to be $3 \cdot 48 \pm 0 \cdot 07$ volts, the two functions thus agreeing to

0·26 volt. The photoelectric sensitivity increased by about 30 % on raising the temperature from air temperature to about 1000° C. G. E. B.

3641. Study of Electric Oscillations by Means of a Discharge Tube. Y. Ikeda, E. Kato and M. Mori. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 227–229, *June*, 1929. *In English.*

A discharge tube was arranged in series with a horn gap across the secondary of a transformer, and photographs were taken on a rotating film show that such an arrangement gives a convenient means of studying the instantaneous electric oscillations occurring when spark or arc discharges take place across the gap. Frequencies up to about 20,000 per second are distinguishable. Further details and the results of further investigations on these lines will be published later. A. W.

3642. Rectification of H.T. Alternating Current. Y. Ikeda and M. Mori. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 230–232, *June*, 1929. *In English.*

The discharge tube method described previously [see preceding Abstract] was used to study the rectification of high-tension alternating current by kenotrons, condensers and inductances. A number of photographs are given showing the effects obtained with the discharge tube inserted in different parts of the circuit. A. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

3643. Relation between Residual Thermoelectricity and Diameter of a Wire. T. Tsutsui. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 194–196, *May*, 1929. *In English.*

A continuation of previous work [see Abstract 2292 (1929)]. The relation is sought between the average diameter of a wire and the average amplitude of fluctuation of e.m.f. along its length produced by local heating. A nickel wire of diameter varying from 0·031 to 0·4 mm. is stretched between two electrodes kept at constant temperature, and is locally heated. The e.m.f. E produced is recorded photographically. From the e.m.f.-position curves, the e.m.f. at every cm. was measured, and its r.m.s. value, $\sqrt{\overline{E^2}}$, obtained. This value is found to give a straight line when plotted with $r^{3/4}$, where r is the radius of the wire. G. E. A.

3644. Thermoelectricity of Nickel Wire. T. Tsutsui. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers.* No. 195. *pp.* 93–110, *June* 26, 1929. *In English.*

An experimental examination of the effect of strain produced in thin wires on the thermoelectric e.m.f. Nickel wire was employed, and the effect of the average diameter of the wire on the mean square amplitude of e.m.f. along the wire investigated. A helical winding of the wire and subsequent stretching straight produced a condition where the strained part behaved as a different metal, *i.e.*, a thermoelectric current flowed from the unstrained portion to the strained portion of the hot junction. The effect of twist was similar to that of helical strain, but the sense of the current was opposite. The e.m.f. produced by pure torsion did not always increase with the increase of the number of turns of twist, but fluctuated. A serrated or zigzag bending of the wire and subsequent straightening yielded results similar to those of the helix. In all cases no relationship was evinced between the thermoelectric properties and the enantiotropic polarity produced by mechanical distortion. Torsional e.m.f. was in the

V.3
192

same direction as that noted by Kelvin, but helical and zigzag were in the opposite direction. This may be due to residual strain in the wire due to incomplete removal of stress in the experiment. Subsequent annealing of a previously strained nickel wire showed a great disturbance in e.m.f. fluctuation, but no decrease of e.m.f. This may possibly be allied to Borelius' explanation of the surface effect on the metal. Aluminium wire, although possessing the same atomic arrangement as nickel, when similarly treated to nickel in the form of wire, showed no sensible e.m.f. produced by mechanical strain. The mean square amplitude of the e.m.f. along the wire increased with an increase of diameter of the wire. This may partially be explained by assuming that the peripheral or zonal part of the wire makes some contribution to the thermoelectric properties. S. G. B.

3645. Electrical Penetration of Solid Bodies. P. Böning. *Zeits. f. Physik*, 56. 7–8. *pp.* 446–457, 1929.

The mechanism of the electrical penetration of solid bodies is interpreted on the basis of ion adsorption at the inner boundary surfaces. Expressions are derived in the paper which relate the dependence of the penetration voltage with the thickness and temperature of the substance. By comparison with measurements, it is shown that the theory fits the data. The subject of thermal penetration is bound up with and limited by that of ionic penetration. H. H. Ho.

3646. Dielectric Polarisation of Liquids. Part IV. Dependence of Molar Refraction upon Concentration in Mixtures. C. P. Smyth, E. W. Engel and E. B. Wilson, Jr. *Am. Chem. Soc., J.* 51. *pp.* 1736–1744, *June,* 1929.

The results obtained from measurements of the refractive indices for the sodium line at 20° of a large number of mixtures of fifteen pairs of organic liquids are used to calculate the molar refractions of the liquids. The molar refractions of the components of the mixtures are found to be independent of the concentration to within 0·07 %. It follows that the contribution of induced electronic shifts to the polarisation of a molecule of one of these substances is practically unaffected by the surrounding molecules. The independence of composition shown by the molar refraction of the alcohols is advanced as evidence against the sharing of electrons between their molecules to bring about molecular association. [See Abstract 2826 (1928).] T. H. P.

3647. Electric Moments of Primary Alcohols. P. C. Mahanti and R. N. Das Gupta. *Indian Journ. Phys.* 3. *pp.* 467–475, *June* 15, 1929.

The paper deals with the determination of electric moments of a number of primary alcohols by the well-known bridge method. The value obtained for each alcohol is nearly the same, thus indicating that the oxygen atom of the OH group in alcohols is similarly polarised. AUTHORS.

3648. Thallium Photoelectric Cells. Q. Majorana. *Accad. Lincei, Atti*, 9. *pp.* 517–519, *April* 7, 1929.

Some notes on the history of the thallium oxy-sulphide cell (" thallophide "). E. E. F. d'A.

3649. Photo-E.M.F. in Selenium. R. L. Hanson. *J.O.S.A. and R.S.I.* 18. *pp.* 370–382, *May*, 1929.

Shows that the photo-e.m.f. in a selenium cell over a wide range is independent of the current through the cell and bears a linear relation to the intensity of illumination. The photo-e.m.f. sensitivity has a maximum for the visible spectrum in the region $\lambda = 490m\mu$. It is conclusively shown that the photo-e.m.f. cannot be a thermal-e.m.f. No direct relation between the photo-e.m.f. and the photo-conductivity is in evidence. E. E. F. d'A.

ALTERNATING CURRENTS AND MAGNETISM.

3650. Laboratory Experiments with Alternating Current. P. F. Gaehr. *J.O.S.A. and R.S.I.* 18. *pp.* 488–491, *June,* 1929.

When alternating current supply and an arc lamp are available, they can be used in single experiments to illustrate the motion of a tuning fork and of waves on liquids, heat phenomena, phase change on connecting a heavy motor to the line, audio-oscillator, calibration, etc.

W. H. Ge.

3651. Apparatus for Thermomagnetic Analysis. R. L. Sanford. *Bureau of Standards, J. of Research,* 2. *pp.* 659–670, *April,* 1929.

A description of the apparatus set up at the Bureau of Standards for thermomagnetic analysis, and typical results obtained by its use. The magnetic effects occurring during cooling or heating a material are studied, with special reference to their interpretation in terms of structural changes or transformations. The analysis can be accomplished in two ways, *viz.*, by fixed temperatures and variable magnetic fields, or by fixed magnetic fields and variable temperatures. The latter method is utilised as being most convenient. The magnetometer used is of the astatic type and is fully described. The paper concludes with curves showing the heating curve of pure iron, the heating curve for commercially pure nickel, the heating and cooling curves for annealed iron carbon alloy of eutectoid composition, and the heating curve for malleable cast iron. An interesting curve is also shown for the latter after it has been heated seven times to 800° C. In the ordinary curve there is no trace of an inflection at 215° C., but after heating seven times the well-known cementite inflection is seen, showing that, as a result of repeated heatings, some of the iron has combined with the carbon to form carbide. S. G. B.

3652. Gyromagnetic Effect and Magnetic Deflection of Atomic Rays on the Basis of the New Theory of Magnetism. K. Honda. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 190–193, *May,* 1929. *In English.*

For the first effect, it is shown that the ratio of the resultant angular momentum to the resultant magnetic moment, in the case of ferromagnetic atoms, is m/e. This is half the value obtained by the ordinary theory, but agrees with the observed ratio. In the second effect, without assuming the quantum distribution, the deflection of atomic rays in a magnetic field is explained by means of the Larmor precession. The field causes a gyroscopic motion to take place in the flying atoms, so that one-half of the atoms have their magnetic moments in the direction of the field, and the other half in that opposite to it. Two atomic rays are thus formed, as in the case of Ag, Cu and other atoms. The behaviour of the ferromagnetic atom is also explained. G. E. A.

3653. Magnetostriction and the Phenomena of the Curie Point. R. H. Fowler and P. Kapitza. *Roy. Soc., Proc.* 124. *pp.* 1–15, *May* 2, 1929.

A discussion of the application of the Heisenberg theory of ferromagnetism to account for the large change of specific heat on passing through the Curie point, the essence of the phenomenon of recalescence. The relatively large change of volume on passing through the Curie point and the phenomenon of magnetostriction have not previously been dealt with theoretically, and the present paper, based on Heisenberg's theory, is an attempt to supply this theoretical relationship. S. G. B.

3654. Paramagnetism. R. Brunetti. *Accad. Lincei, Atti*, 9. *pp.* 754–760, *May* 5, 1929.

Works out a theory of paramagnetic condition induced by the action of ions exposed to powerful molecular forces. A. D.

3655. Paramagnetic Properties of Rare Earths. B. Cabrera and A. Duperier. *Comptes Rendus*, 188. *pp.* 1640–1642, *June* 24, 1929.

It is shown that the sulphates and oxides of Gd, Tb, Dy, Ho and Er conform to the Curie-Weiss law: $\chi(T + \Delta) =$ constant, but that the specific susceptibilities of the sulphates and oxides of Nd, Sm and Eu are better expressed by the equation: $(\chi + k)(T + \Delta) =$ constant. This equation also holds for Pr, Tu and Yb. The term k represents a susceptibility which is independent of the temperature, and which is paramagnetic for elements in the neighbourhood of Sm, but diamagnetic for Tu and Yb. Its presence may be attributed to a deformation of the atom. [See also Abstracts 1555 (1925) and 173 (1926).] G. E. A.

3656. Anomaly in the Diamagnetism of Gases. Part IV. A. Glaser. *Ann. d. Physik*, 2. 2. *pp.* 233–248, *June* 28, 1929.

Discusses sources of error due to the imperfect elimination of oxygen, and the results obtained by Hamar, who used the same method of measurement. [See Abstract 2832 (1929).] E. E. F. d'A.

3657. Magnetic Anisotropy of Naphthalene Crystals. S. Bhagavantam. *Roy. Soc., Proc.* 124. *pp.* 545–568, *July* 1, 1929.

The remarkable degree of anisotropy of this substance is indicated by its principal specific susceptibilities, which are: along the b axis, -710×10^{-7}; along the c axis, -390×10^{-7}; along a line perpendicular to these, -1590×10^{-7}. The results suggest that the molecules in the cell are so orientated as to have their planes parallel to the bc plane of the unit cell in the crystal. Also the maximum axis of the magnetic ellipsoid coincides roughly with the minimum axis of the optical ellipsoid, and *vice versa*. This leads to a simple explanation of the strong positive birefringence exhibited by aromatic liquids in a magnetic field. G. E. A.

3658. Tilting Deviations in Magnetic Declinations. W. J. Peters. *Terr. Mag.* 34. *pp.* 93–115, *June*, 1929.

Experiments were made by swinging compasses in a wooden swing for the purpose of investigating deviations caused by the ship's rolling motion. Results obtained with various types of compasses are submitted in two tables. Dynamic deviations, the kinetic equilibrium error, and conditions other than those considered in these two theories are briefly discussed. Equations are given for computing the direction and relative strength of the apparent gravitational field as affected by the accelerations of the rolling motion. These are used to determine the maximum angle of tilt produced by the maximum angle of roll. The kinetic equilibrium error for an angle of tilt in one direction is shown to be different for an equal angle of tilt in the opposite direction for certain elements in certain directions of the axis of tilting and hence give rise to deviations. Examples are given for the three magnetic elements for instantaneous values of tilting. The computed deviation in declination that results in the case of a magnet having a large moment of inertia, constrained to move about an axis parallel to the radius of swing, and having considerable damping has been found to be much smaller than would be indicated by the results of the experiments for the same conditions. It is concluded that this theory of tilting deviations does not account for the whole deviation observed and must be regarded as only contributing a part of the effect, as does also the theory of dynamic deviations. AUTHOR.

3659. Preliminary Results of Ocean Magnetic Observations on the "Carnegie." J. P. Ault. *Terr. Mag.* 34. *pp.* 117–121, *June*, 1929.

The results are contained in a table of magnetic values at different sea stations, and were obtained on cruise VII of the *Carnegie* from Callao to Samoa during the period Feb. 5 to Mar. 13, 1929. Other observations included those of atmospheric electricity, potential gradient, electrograms, oceanographic work, depths by sound echo, and balloon flights. [See also Abstracts 987 and 2839 (1929).] G. E. A.

3660. Variation of Magnetic Anomalies. W. N. McFarland. *Terr. Mag.* 34. *pp.* 143–146, *June*, 1929.

This paper describes briefly a method of isogonic chart construction, and the distribution of station anomalies, or differences of observed values from the average condition shown by the chart. The distribution is shown to be according to the law of occurrence of accidental errors. The available data are given in a table, and a figure shows the correspondence of the observational data and the theoretical curve in an individual case. AUTHOR.

3661. Summary of the Year's Work, Department of Terrestrial Magnetism, Carnegie Institution of Washington. J. A. Fleming. *Terr. Mag.* 34. *pp.* 151–153, *June*, 1929.

An extract from the year-book for 1927–28. Reference is made to the preparations for the seventh cruise of the *Carnegie* which began on May 1, 1928, and will continue for three years. Note is made of the success in determining the inclination by the marine earth-inductor. The application of the inductor to the determination of intensity is not yet solved. Improvements have been made in the procedure for measuring effective heights of the Kenelly–Heaviside layer, and quite unambiguous results as to height have been obtained. The application of high voltages to the production of high-speed electrons is being continued. Earth-current records were obtained throughout the year at the Watheroo and Huancayo Observatories. G. E. A.

3662. Origin of the Permanent Magnetic Fields of the Sun and Earth. R. Gunn. *Terr. Mag.* 34. *p.* 154, *June*, 1929.

A preliminary note. A study of long free-path phenomena which take place in rarefied atmospheres leads to the conclusion that the currents are inadequate to account for the observed magnetic moments. The permanent fields arise from the thermal energy of the body and not from its rotation. Drift currents are set up which are in such a direction that magnetic regeneration can take place, and a large field is built up. The present theory leads to nearly the correct observed value for the magnetic moment of the earth. G. E. A.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

3663. Light Therapy. H. P. Gage. *A.I.E.E., J.* 48. *pp.* 477–478, *June*, 1929.

A general account of the use of ultra-violet light therapeutically, with some warnings as to impossible claims. W. V. M.

3664. New Photo Applications in Therapeutics. F. Holtzmann, *E.T.Z.* 50. *pp.* 927–929, *June* 27, 1929.

The many uses of ultra-violet light in therapeutics are described, particularly with respect to the treatment of rickets, improving efficiency for sport and manual occupations, and neutralising the effect of snake poisons. Radiated ergosterol is found to be especially suitable as a food for muscular weakness. Application to tuberculosis also receives description. H. H. Ho.

3665. Experimental and Theoretical Studies in X-Ray Intensity Measurements. Part II. Distribution of X-Rays within an Irradiated Medium. W. V. Mayneord. *Brit. J. of Radiology*, 2. *pp.* 267–296, *June*, 1929.

This is a continuation of a previous paper [see Abstract 2847 (1928)]. The present paper is a review of "deep-therapy" physics, and commences with the definition of "quality" of radiation, particularly by photometric evaluation of films obtained by use of the Seemann X-ray spectrometer. The definition and measurement of "quantity" of radiation is then considered and the ionisation method of measurement, used in conjunction with a water phantom, described. With this basis the question of quality and quantity is considered with respect to variations due to (1) filtration, (2) intensity distribution along the central axis of the radiation, and (3) the effects of field size, *i.e.*, of scattered radiation. Isodosis curves are then illustrated for constant values of voltage, focal distance and field area after filtration, via 0, 4, 6, 8 cm. of aluminium. Also the effects of varying field shape, as well as a sloping beam of X-rays, as used in cross-fire methods of irradiation, are described and illustrated. The result is that the depth dose D% can be expressed as $D\% = D_0 + K'(1-e^{-\mu a})$, where D_0 = percentage depth dose with a very small field, a the field radius and μ the coefficient of absorption of the radiation. Agreement and variation with prior results of Holfelder and Dessauer are considered. B. J. L.

3666. Efficiency Conditions in Diathermy Circuits. L. H. Clark. *Brit J. of Radiology*, 2. *pp.* 315–320; *Disc.*, 320, *June*, 1929.

When an electrolyte is placed in the resonant circuit of a diathermy machine, the apparent energy (amperes × volts × time) required to produce a given rise of temperature is modified by: (1) a change in the frequency of the diathermy current, the apparent energy producing the given temperature rise diminishing as the frequency is reduced; (2) the insertion of condensers in parallel or in series with the electrolyte, especially for values of the capacity near that which produces resonance. The apparent energy is a maximum under resonance conditions. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

3667. Interferometric Investigation of Adsorption by Pure Carbon from Non-Aqueous Binary Systems. F. E. Bartell and C. K. Sloan. *Am. Chem. Soc., J.* 51, *pp.* 1637–1656, *June*, 1929.

The use of the interferometer in measuring the change in concentration due to adsorption from non-aqueous solutions is discussed, and the method used to measure the adsorption by carbon from a number of binary non-aqueous systems, *viz.*, of α-bromonaphthalene, benzene, and ethyl carbonate from dilute solutions in ethyl alcohol, over the entire concentration range. In each case the adsorption curve is S-shaped, and the component having the higher adhesion tension against carbon is the one which is adsorbed to the greater extent. When the component of lower adhesion tension is present in very low concentration it is, however, preferentially adsorbed. An equation $H\Delta x/m = ax^n\ (1-x) - b\ (1-x)^d x$ is used to represent the preferential adsorption over the entire concentration range. The adsorption at a given interface is found to depend on the rate of change of that particular interfacial tension with the concentration of the bounding phases. The importance of the measurement of adhesion tension values of solutions is pointed out, since the rate of change of adhesion tension is equal and opposite in sign to the rate of change of interfacial tension with concentration. The Gibbs principle is restated as follows: "There will be an excess in the concentration of the solute in the interfacial layer if the rate of change of the adhesion tension of the solution against the adsorbent is positive." It is pointed out that the usual formulation of the principle of Gibbs does not take into consideration a number of existing factors.

H. H. Ho.

3668. Surface Films and Surface Solutions of Myristic Acid. F. Émir. *Comptes Rendus*, 188. *pp.* 1667–1670, *June* 24, 1929.

The hypothesis of Marcelin that in films formed by spontaneous spreading of fatty acids on water the molecules are in juxtaposition when the surface solution is saturated, previously confirmed for oleic acid, is shown to apply also in the case of myristic acid. Owing to slight solubility in water, the thickness of the film is determined on a $N/20$ solution of hydrochloric acid ,at 19°–21° C. At the point of saturation, where the pressure of the surface film is 14 dynes/cm., the thickness of the film is 16 Å., each molecule occupying a surface of 26 $Å.^2$ The thickness of the film is equal to half the elementary lattice spacing (which allows of two molecular layers) of the solid acid.

A. J. M.

3669. Rate of Solution of Copper in Various Solvents. R. Glauner. *Zeits. f. phys. Chem.* 142. *Abt.* A. 1. *pp.* 67–91, *June*, 1929.

Apparatus is described for the determination of the rate of solution of metals, the results being accurately reproducible. Two series of determinations were made with thin copper sheet, the specimens in the first series having irregular crystalline orientation, the crystals in the second having a predominant orientation in a definite direction. The solvents employed were HCl, HBr, HNO_3, H_2SO_4, $HClO_4$, CH_3COOH, $HCl + H_2O_2$, $H_2SO_4 + H_2O_2$, $CH_3COOH + H_2O_2$, $(COOH)_2 + H_2O_2$, $(NH_4)_2$, S_2O_8 and

NH_3. The progress of solution is represented quantitatively by a differential equation of the form $dx/dt = a + kx$, where x is the quantity of copper in solution and a and k are constants, a represents the initial velocity of solution which is dependent on the nature and concentration of the solvent; k expresses the autocatalytic effect of the copper already dissolved. The validity of the equation is confirmed for a series of solvents. The applicability of the Nernst–Brunner diffusion theory to the solution of copper is discussed: it is shown that the constants a and k are proportional to the diffusion constants of the solvent and the resultant copper salt. The differences observed in the rate of solution of specimens having different crystalline orientations cannot be reconciled with the diffusion theory in its present form. A. J. M.

3670. Emulsions: Stability, Area per Molecule in the Interfacial Film, Distribution of Sizes and the Oriented Wedge Theory. W. D. Harkins and N. Beeman. *Am. Chem. Soc., J.* 51. *pp.* 1674–1694, *June*, 1929.

It is pointed out that the three most important problems in this branch of colloid science are: (1) the number of molecules of the emulsifying agent per unit area of the oil-water interface ; (2) the stability of emulsions and the effect of ageing; and (3) the oriented wedge theory of emulsions. According to the authors the requirements of the first problem seemed to necessitate the application of a microscopic method. The authors applied a statistical method, using a projection apparatus in conjunction with a microscope. The conclusions arrived at are summarised in full. J. K.

3671. Osmotic Pressures in Acetone Solutions. M. J. Murray. *J. Phys. Chem.* 33. *pp.* 896–920, *June*, 1929.

A modified Raoult's osmometer is described for the measurement of osmotic pressures of non-aqueous solutions. Vulcanised rubber membranes are used. The solutions studied were those of water in acetone, and, owing to the permeability of the membranes towards water, a special technique was developed. It was found that for a given solution the osmotic pressure depended upon the thickness of the membrane and the ease with which water was prevented from passing through it. The values of the osmotic pressure correspond to a molecular weight of about 36. Using a modified Kahlenburg osmometer the osmotic pressures of sodium iodide solutions in acetone were measured. The results correspond with the theoretical within the range of experimental error. Solutions of succinic, malic, tartaric and citric acids in acetone have also been studied. The rubber membranes were appreciably permeable to the two former, but almost impermeable to the latter. For citric acid solutions, the measured osmotic pressures are 12–15 % lower than those calculated according to the gas laws, but only 6–11 % lower than the values calculated from the lowering of vapour pressure. It is suggested that, if the membranes were truly semi-permeable, the measured osmotic pressures would be those required by the gas laws. F. J. W.

3672. X-Ray Investigation of the Gold-Mercury System. A. Pabst. *Zeits. f. phys. Chem.* 3. *Abt. B.* 6. *pp.* 443–455, *June*, 1929.

Amalgams were made up by trituration of mercury and gold powder, followed by annealing *in vacuo* at 130° to 300° C. for periods up to 90 hours. X-ray spectrograms were obtained by the powder method. From 0 to 15 % by weight mercury the only constituent is the α solid solution (face-centred cubic lattice, lattice constant of saturated solution 4·107 Å.). From 17·25 to 20 % mercury the amalgams consist of a hexagonal phase and the saturated α solid solution; with 25 % mercury only the hexagonal phase is present, while at 30% mercury numerous lines appear, corresponding to another phase, but the hexagonal phase persists up to 50 % mercury. The hexagonal phase has a restricted range of composition around 25 % mercury: its spectrogram corresponds to a close-packed hexagonal lattice, having the constants $a_0 = 2\cdot908$ Å. and $c_0 = 4\cdot791$ Å., the elementary cell containing $Au_3Hg/2$. The constitution of amalgams richer in mercury is uncertain, but at room temperature there appear to be two phases having restricted compositions close to 60 and 66–68 % mercury, and possibly corresponding to Au_2Hg_3 and $AuHg_2$, though the latter is doubtful. A. J. M.

3673. Tempering of Quenched Steels. P. Chevenard and A. Portevin. *Comptes Rendus*, 188. *pp*. 1670–1672, *June* 24, 1929.

Specimens of two steels, one containing 1·5 % C. and 2·26 % Mn, the other 1·5 % carbon and 2·26 % chromium, may be retained in the austenitic condition by quenching. In this state the Brinell hardness is 200 in both cases, and on suitable tempering the hardness of both specimens rises to about 400. Dilatometric observations, however, show that the mechanism of tempering is not the same in the two steels. On heating the manganese steel the austenite is transformed into sorbite (iron carbide and α-iron). No further physico-chemical change occurs during cooling, the heating having restored the steel to the state stable at ordinary temperatures. In the chromium steel, during heating the austenite yields a mixture of complex iron-chromium carbide and austenite of reduced carbon content. On cooling a secondary hardening occurs through the conversion of this austenite into martensite. A. J. M.

3674. Fracture of Iron at Low Temperatures. F. Sauerwald and K. A. Pohle. *Zeits. f. Physik*, 56. 7–8. *pp*. 576–578, 1929.

Test pieces of iron plate, in which large crystals had been produced by decarbonisation, straining and annealing, were fractured by tensile impact at temperatures of − 10° C., − 20° C., − 80° C., and − 170° C. The fracture in every case was transcrystalline, and never intercrystalline. At − 20° C. fracture was accompanied by a considerable reduction of cross-sectional area, but at −170° C. the deformation was very small.

A. J. M.

3675. X-Ray Investigation of Copper-Magnesium Alloys. G. Grime and W. Morris-Jones. *Phil. Mag.* 7. *pp*. 1113–1134, *June*, 1929.

A series of eight alloys containing from 0 to 47 % magnesium was examined by the powder method. Sahmen's equilibrium diagram [see Abstract 498 1908)] is confirmed with the sole exceptions that two new regions of solid solution are revealed: α-phase, a solution of magnesium in copper up to about 3 % of magnesium; and β-phase, a region of solid solution on either side (to about 2·3 %) of the Cu_2Mg composition. The practical insolubility of copper in magnesium is confirmed. The α-phase has a face-centred structure, a_0 varying from 3·610 Å. in copper to 3·634 Å. at the limit of solution. The β-phase has the face-centred spinel structure with 8 molecules in the unit cell, a_0 increasing from 7·003 Å. to 7·059 Å.

with increasing amounts of magnesium. Mg_2Cu has an hexagonal lattice, unit cell of 8 molecules, $a_0 = 5\cdot281$ Å., axial ratio 3·464. For magnesium $a_0 = 3\cdot206$ Å., axial ratio 1·624. Westgren's results (*Zeit. anorg. Chem.* 174. pp. 1–3, 1928) are in agreement save as regards the structure of Mg_2Cu. C. A. S.

3676. Determination of the Constants of Chemical Equilibrium by Rise of Boiling Point Methods. W. Świętosławski, Z. Błaszkowska and E. Józefowicz. *Acad. Polonaise, Sci. et Lettres, Bull.* 3*a. pp.* 149–167, *March,* 1929. *In French.*

A method for determining the constants of chemical equilibrium by the rise of boiling points was developed. The method was applied to the formation and hydrolysis of ethyl acetate. The basis of the method was the simultaneous observation of the variation of the boiling points of two mixtures, in one of which the products of the reactions of esterification, and in the other the products of hydrolysis. The two mixtures were tending towards the same permanent equilibrium. The constant of K = 3·76 was obtained for the equilibrium constant of the esterification of an equimolecular mixture of acetic acid and ethyl alcohol. The boiling point of the equilibrium mixture, obtained from an initial mixture of one gramme molecule of acetic acid and one gramme molecule of ethyl alcohol, was found to be 76·32° C. at 760 mm. F. J. B.

3677. Velocity of Decomposition of Solid Substances. Part V. Mercurous Carbonate and Hydrated Salts. B. Brużs. *Zeits. f. phys. Chem.* 3. *Abt. B.* 6. *pp.* 427–439, *June,* 1929.

The velocity of decomposition of Hg_2CO_3 has been determined between 125° and 150° C., and for pressures of 500 to 1000 mm. mercury. In all cases the velocity rises to a maximum and then decreases. Expressing velocity v as a fraction of the maximum velocity, and time z as a fraction of the time to reach the maximum velocity, all the v/z curves reduce to a common curve, provided preliminary insolation is excluded and initial grain size remains constant. Variations in pressure and temperature therefore do not change the mechanism of the reaction. It is found that $-(dln2/d\mathrm{T}^{-1}) = \mathrm{E/R} = 17{,}500$ and $dlav/d\mathrm{T}^{-1} = 17{,}000$, while z is proportional to the pressure at constant temperature. Hence the activation increment E has the value 35,000 cal. The rates of dehydration of the following salts have been determined by means of a simple gravimetric method at 25° C.: $MnSO_4,5H_2O$; $ZnSO_4,7H_2O$; $Na_2SO_4,10H_2O$; and the increase in rate of dehydration with reduction in particle size observed. The autocatalytic nature of the decomposition of Hg_2CO_3 and similar reactions is explained on the basis of the crystal structure of the material. A. J. M.

3678. Chemical Equilibria which involve Reactions between Two Condensed Phases. M. Mannheimer. *Am. J. Sci.* 17. *pp.* 534–542, *June,* 1929.

A short report is given on the present standing of research on equilibria between fused salts and metals, and a general method is derived for judging as to the reliability of the experimental results. This method rests on the fact that the points of the equilibrium are located on stoichiometrically computable curves independent of the special law of mass action and independent of the true molecular coefficients. The general equations of transformation of the coordinate system for change of molecular coefficients are derived. AUTHOR.

3679. Synthesis of Ammonia in the Glow Discharge. A. K. Brewer and J. W. Westhaver. *J. Phys. Chem.* 33. *pp.* 883–895, *June*, 1929.

The rate of synthesis of ammonia in the glow discharge has been studied using 3 : 1 mixtures of hydrogen and nitrogen over a pressure range of 4–0·1 mm. In addition the influence of the current, power, design and dimensions of the discharge tube, and the magnetic and electrostatic fields on the rate of synthesis, have been investigated. The reaction was followed by noting pressure change, the ammonia being frozen out by immersion of either (*a*) the portion of discharge tube containing the positive column, or (*b*) the whole discharge tube in liquid air. Under all the experimental conditions studied the rate of formation of ammonia is proportional to the current. It is further independent of the pressure and the potential gradient is the discharge. A magnetic field when parallel to the direction of the discharge has no influence on the rate of synthesis, but if perpendicular increases it considerably. Electrostatic fields have no effect on the rate of synthesis. It is shown that the formation of ammonia in the discharge is a pure gas reaction. The suggestion is made that the reaction is initiated by positive ions. Since the rate of formation of positive ions is proportional to the current, an explanation is provided of the proportionality between current and rate of synthesis of ammonia. It is suggested that this constitutes a new electrochemical equivalence law for chemical reactions in discharge tubes. F. J. W.

3680. Influence of Air and Moisture on the Budde Effect in Bromine. E. B. Ludlam and R. B. Mooney. *Roy. Soc. Edinburgh, Proc.* 49. *pp.* 256–263, 1929.

From a survey of recent work on the action of light on bromine vapour, both dry and in presence of air and moisture, and a discussion of the various explanations suggested for the observed facts, the conclusion is drawn that the influence of water is due to a " poisoning " of the walls of the vessel, which prevents them from catalysing the recombination of bromine atoms. T. H. P.

3681. Influence of the Intensity of Illumination on the Velocity of the Photochemical Union of Bromine and Hydrogen. M. Bodenstein, W. Jost and G. Jung. *Chem. Soc., J. pp.* 1153–1158, *June*, 1929.

It is found that bromine atoms in illuminated bromine are used up in two processes: (1) recombination by three-body collisions in the gas phase; (2) recombination through diffusion to the walls, where they are absorbed until they combine, a process seen to be unimolecular at constant total pressure. The work agrees with that of Briers and Chapman [*Chem. Soc. J.* p. 1802, 1928], as well as the accuracy of the underlying data will permit, and it leads distinctly to the fact that all measurements and theory must be based on bromine atoms and not on the excited molecules. The following reaction mechanism is found for the formation of hydrogen bromide in light: $Br_2 + h\nu = 2Br$; $Br + H_2 = HBr + H$; $H + Br_2 = HBr + Br$; $H + HBr = H_2 + Br$; $Br + Br = Br_2'$; $Br_2' = Br + Br$; $Br_2' + N = Br_2 + N'$ where B_2' is the quasi-molecule and N any molecule at all. H. H. Ho.

3682. Ultra-Violet Light, Insulin and Amino Acid Catalysis. J. M. Ort. *J. Phys. Chem.* 33. *pp.* 825–841, *June*, 1929.

A study has been made on the effects of certain of the amino acids, insulin, ultra-violet light, and the rate of bubbles of the nitrogen gas stirring these solutions. Certain of the amino acids represented by glycine were shown to catalyse the decomposition of hydrogen peroxide and so promote its reaction with the active sugar. Ultra-violet light has a similar but much greater effect. Other of the amino acids as represented by glutamic acid, while lacking at least to a comparable degree this catalytic effect, seem to be of greater influence in developing further reducing intensities, once most of the oxidant is removed and the stronger oxidising conditions are gone. E. E. F. d'A.

3683. Photochemical Reactions in Radiations of Different Wave-Lengths. B. K. Mukerji and N. R. Dhar. *J. Phys. Chem.* 33. *pp.* 850–863, *June*, 1929.

The bleaching of dicyanin in presence of air follows the unimolecular formula. The temperature coefficient of this reaction is 1·35 in the dark and is slightly greater than unity in the light. The reactions between sodium citrate and iodine and sodium malate and iodine are both trimolecular in the dark and the temperature coefficients are 1·64 and 1·61 respectively. The authors' experiments on the influence of light of different wave-lengths on fourteen photochemical reactions show that the greater the acceleration of the reaction due to light, the smaller is the temperature coefficient of the photochemical change. The temperature coefficients in light are greater than unity. E. E. F. d'A.

3684. Proposed Nomenclature for Photochemical Units. M. Bodenstein and C. Wagner. *Zeits. f. phys. Chem.* 3. *Abt. B.* 6. *pp.* 456–458, *June*, 1929.

It is proposed, on analogy with the " Faraday " of electrochemistry, to apply the term " Einstein " (symbol E) to the quantity of light associated with one mole in photochemical reactions. The " light-equivalent " or Einstein would then represent $6 \cdot 06 \cdot 10^{23}$ quanta. The symbol L is suggested for the number of Einsteins. Intensity of absorbed light J_{abs} can be measured in Einsteins per second. By $[J_{abs}]$ is to be understood the number of Einsteins absorbed per litre per second. A. J. M.

3685. Single Potential of the Nickel Electrode. E. Newbery. *Am. Chem. Soc., J.* 51. *pp.* 1429–1436, *May*, 1929.

The variability of the results for the single potential of a nickel electrode obtained by other observers inspired the present author to primarily investigate some of the alleged causes. It was shown that extreme purity of the nickel from other metals appeared to be of small importance. Oxygen is an unimportant impurity, but hydrogen was shown to be dangerous and must be rigidly excluded. Freshly prepared electrolytic nickel contains large quantities of hydrogen, and the single potential of such an electrode may differ up to as much as 0·5 volt from that of a similar gas-free electrode. Extreme purity of the electrolyte was also found to be of minor importance. For copper electrodes the nature of the electrode surface has been shown to be immaterial, but in contrast to this it has been found that the difference of potential between a highly polished and a rough nickel surface is of the order of 0·4 volt. Reproducible results within this limit could be attained by using emery of varying degrees of coarseness for the preparation of the surface. There seems no adequate reason why any variability should be ascribed to nickel sulphate, since it is stable in solution. Chemical action occurs between electrode and electrolyte. The action is small, but the effect upon single potential is great. A difference in the single potential of as much as 0·3 volt has been noted when a highly polished nickel rod is immersed in a solution of nickel sulphate for some hours, although the surface appearance is unchanged, even when viewed microscopically. Three distinct experimental methods were employed for the potential measurement and are fully described. The values obtained varied with the condition of the electrode surface, with time and with relative motion between electrode and elctrolyte. Constant and reproducible values are obtained when the nickel is treated anodically with a small current density insufficient to produce passivity, the potential being measured when the current is not passing. These values may or may not represent truly reversible potentials. Nickel amalgam is more erratic than solid nickel for single potential measurements. The hypothesis is put forward that solid nickel contains two allotropes having normal single potentials of approximately 0·5 and 0·0 volt respectively, referred to the normal hydrogen electrode. The equilibrium mixture of these allotropes ordinarily found in massive nickel has a corresponding potential of 0·17 volt. The above theory, together with that of hydration of nickel ions, offers a possible explanation of the observed variations in single potential as well as of the retardation phenomena evident during the electrolytic deposition of nickel. It may also afford a clue to the cause of certain phenomena observed during the electrodeposition of nickel. S. G. B.

3686. Galvanic Electricity and Cohesion Pressure. Space Energy. R. v. Dallwitz-Wegner. *Zeits. f. Elektrochem.* 35. *pp.* 344–349, *June*, 1929.

Developing the considerations of previous papers [see Abstract 1387 (1928)] the author calculates the e.m.f. of various cells (Daniell, Bunsen, hydrogen-oxygen) and finds values which are in approximate agreement with thermodynamical data, but of the opposite sign. His space energy E is the energy contained in the substance at the temperature corresponding to a definite value of its cubical expansion coefficient δ: thus $E = R_a/\delta = 10{,}000KV = 10KM/\gamma$, where R_a is the gas constant (841 kgm. per mol.), K the cohesion pressure, M the molecular weight and γ the density (water 1) of the substance. The equations deduced are those of thermodynamics when $1/\delta$ is substituted for the absolute temperature. H. B.

3687. Modification of the Moving Boundary Method for the Determination of Transference Numbers. H. P. Cady and L. G. Longsworth. *Am. Chem. Soc., J.* 51. *pp.* 1656–1664, *June*, 1929.

In this new method, in which rising boundaries are used, the boundary starts at the surface of the metal electrode which furnishes the " indicator " ions by electrochemical solution of the metal. When applicable, this method furnishes a simpler means of obtaining boundaries than has been so far proposed, and it also avoids the necessity of making measurements with indicator solutions of varying concentration, since it has been shown experimentally that there is an automatic adjustment to the condition $C/C' = T_c/T'_c$ (C, C' and T_c, T'_c being respectively the normality and kation transference numbers of the leading and indicator solutions).

H. H. Ho.